KNOWLEDGE
AN
ILLUSTRATED MAGAZINE
OF
SCIENCE, LITERATURE, & ART

LONDON: NOVEMBER 1, 1886.

THE EARTHQUAKE IN AMERICA.

IN several respects the great earthquake which, on August 31, shook the eastern half of the United States, is remarkable beyond all others whose records have reached us. It suggests, though it does not actually demonstrate, the existence of a cause of earthquakes such as had not been before taken into account. It also raises the question whether those seismologists are right who assert that more earthquakes occur now than in former times, the increase in the number of recorded earthquakes being, they maintain, far greater than can be explained by the increase, great though that has doubtless been, in the care with which all signs of subterranean disturbance are recorded.

The earthquake of August 31 was preceded by certain signs of widespread subterranean activity which may not, indeed, have been connected with it, yet require to be recorded as among the indications to which we may have to attend in forming an opinion of the probable cause of the disturbance which presently followed.

Early on August 31 an artesian well 4 inches in diameter, which had been bored to a depth of 180 feet, near Belle Plains, Ia., suddenly burst, and immediately an immense volume of water was forced into the air to a height of several hundred feet. This increased in size until a stream of water fully 16 inches in diameter (or sixteen times the cross section of the boring) was formed. The rush of this stream was as irresistible as the action of dynamite. Two "rivers," the Mayor of Belle Plains announced in a despatch to Chicago on the afternoon of August 31, "have been formed by this water-burst, which are running through the town at the rate of twelve miles an hour, and are carrying everything before them." An attempt was made to insert 16-inch boiler iron tubes into the well; but they were instantly blown out, as if they had been straws, and hurled high into the air. Then the Iowans tried to fill up the opening of the well with sand and stone—fifteen cart-loads of stone were emptied into the well; but they were instantly blown out and forced upwards, as if by a bursting magazine of gunpowder. The same happened when bags of sand were cast into the well. The men of the North-Western Railroad sent a large gang of men—"navvies," as we should call them—to help to dam the outlet, and they were helped by the county bridge gang. But for more than a day no abatement in the flow of water was perceptible. To quote from an account in the Chicago newspapers, the rushing rivers formed by the flow of waters continued to wash the channel deeper and wider, while the basin formed by the immense volume of water spread so as to form a wide lake over the lowlands in the vicinity. Until September 3, when a slight diminution was for the first time perceptible, it was calculated that the daily flow amounted to five million gallons of water. On the 4th it was found possible to sink a cone and a tube to regulate the outflow; but the danger now remains that the whole region from beneath which this subterranean river burst forth may cave in.*

It may possibly be that there was no connection between this outburst in Iowa and the earthquake which followed a few hours after, and was felt over a part of this same region, and violently at places much farther away from the centre of disturbance. Still the coincidence is too remarkable to be left unnoticed.

In like manner there may possibly have been no real connection between the great earthquake and a remarkable disturbance in Montana, which preceded it by three days. On Saturday, August 28, at the very time when a great earthquake shook Greece and Italy, the Excelsior Geyser, in the Yellowstone Park, Montana, burst suddenly into violent activity. Four years had passed, during which it had been quiescent. Its activity four years ago was remarkable, but short lasting. Its recent outbreak was of a somewhat similar character. When we consider the distance of Montana from South Carolina it seems almost as difficult to imagine that there was any connection between the subterranean disturbances in these places, as to imagine that the Excelsior Geyser was affected by the earthquake in Greece. It is indeed difficult for persons in England to appreciate fully the enormous extent of the United States. Accustomed to see in atlases a map of the States, as there is a map of the German Empire, the idea is conveyed that the States form a country resembling a European country, instead of the whole of Europe, in extent. From the Yellowstone Park to Charleston, S.C., is a distance of about 1,800 miles, or some 200 miles more than the distance separating Athens from London.

Yet it must be remembered that the direct effects of the great earthquake at Lisbon were recognised over an even greater distance than this, having affected not only the northern part of the Scandinavian peninsula, but even the eastern shores of North America. The waves of disturbance which swept around South Carolina on August 31 last were felt in the most striking manner as far north as Milwaukee on the western shore of Lake Michigan; and we shall probably hear, ere long, of minor disturbances noted at much greater distances even than this.

Of other signs of an approaching subterranean disturbance I need say little here. In the States the opinion was commonly expressed that a certain stillness and heaviness in the air, which many said they had noticed for some time before the earthquake, indicated the disturbed condition of the earth's interior. We know that such an idea is entertained in volcanic regions, as by the inhabitants of Naples in regard to Vesuvius, and by the inhabitants of Palermo and Messina in regard to Etna. That such atmospheric peculiarities may justly be regarded as premonitions is likely enough, but that they are indications of disturbances actually in progress is only less utterly inconceivable than the doctrine gravely propounded in some quarters that the recent earthquake was caused by electrical disturbances, indicated after it had happened by the occurrence of a magnetic storm in New York (State). It seems very likely that when the underground conditions have for a long time been in a critical condition, tensions having accumulated

* In passing, I may notice how such cases as these demonstrate the eruptive power which may accompany the outflow of fluid matter from the earth. It is often assumed by geologists that the outflow of lava in the great eruptions of the tertiary era were quiet, although the forces which produced them may have been intensely energetic. Certainly any eruptive action which may have accompanied the outflow has left no trace of its effects; but in like manner any one who should visit Belle Plains a year hence would find no trace of the eruptive, geyser-like energy with which water was flung forth—only the signs of the great lake itself which the water formed.

XUM

until relief is required in some direction, the changes of atmospheric pressure, indicated by abnormal atmospheric conditions, may be as the last feather on the back of the proverbial camel, and may actually bring about the earthquake in the same sense that the touch of a feather on a hair-trigger may bring about the explosion of the gun. But the still and heavy air (as we are apt to call it, though usually the barometer gives a different account of the matter) tells us nothing of the state of the earth's interior. It only tells us that if the earth's interior is in a state of strong tension nearly balanced by resisting forces, a disturbance is very likely to follow the abnormal condition of atmospheric pressure. When we remember that an alteration of two inches in the height of the barometer means a change of half a pound in the atmospheric pressure on each square inch of the earth's surface, and that often the area beneath which the tensions resulting in an earthquake are at work may be twenty miles square, we see that such an alteration of atmospheric pressure as often precedes a great storm may very well serve as trigger-puller to the earth's imprisoned forces and bring about an earthquake. In a region ten miles square, there are one hundred square miles, each containing about three millions of square yards, in each of which are nearly thirteen hundred square inches. So that there are not far from 400,000 millions of square inches in a surface of ten miles square. Thus a difference of two inches in the height of the mercurial barometer on a surface of that area would mean nearly 200,000 millions of pounds', or 100 millions of tons', difference of atmospheric pressure. This would be a mere nothing compared with the tremendous pressures which such a portion of the earth's crust is able to sustain and resist. But regarded as a change of pressure, it would be a very potent factor in a nicely balanced contest between the earth's crust and the reaction of interior strains and tensions. One may represent the difference of atmospheric pressure even more effectively; perhaps as equivalent to a flood of water covering the whole of the one hundred square miles to a depth of more than $2\frac{1}{4}$ feet.

As regards magnetic and electric disturbances, it may suffice to mention that those observed on the present occasion followed the earthquake, and that it might be taken almost for granted that no great subterranean disturbances could possibly take place without electrical and magnetical phenomena of an unusual kind being observed. To imagine, as some have done, that a magnetical storm, even if it had chanced to precede an earthquake, could have brought the earthquake about, is almost as preposterous as that blunder which set the scientific world on the broad grin nearly a quarter of a century ago, when it was gravely suggested that the *Great Eastern*, then missing, might have gone down in the great magnetic storm announced at Greenwich!

The earthquake of August 31 was felt at Charleston at 9.55 P.M. It has been stated since that the wave of disturbance travelled from this region of greatest disturbance in all directions. But, as a matter of fact, the shock was felt earlier in places at a distance. I have before me the leading St. Louis paper for September 1, in which, in an article written before the news from Charleston had been received, the times recorded at various stations are indicated thus:—At St. Louis, 8.20; at Indianapolis, 8.52; at Nashville, 8.54; at New York, 8.57; at Detroit, 9; at Louisville, 9.13; at Cincinnati, 9.16; at Cleveland, 9.38; at Atlanta, 9.50; at Washington, 9.55. (The remark is added, reading strangely and sadly in the light of the news which arrived but a few hours later: "As has been usual with such phenomena in the United States, very little damage to property was done, and there was no loss of life.") It is barely possible, however, that in reality the shock thus timed was felt earlier in Charleston. For the hour mentioned above was not actually recorded. The people at Charleston were naturally little disposed to make time records when their lives seemed appallingly endangered. No telegraphic news of the disaster was sent out that night, insomuch that it was not until the morning of September 2 that the greater part of the States heard of the terrible effects of the shock in Charleston. The record by which the time of the chief shock was inferred was simply the clock of St. Michael's Church, which had stopped at 9.55 P.M.

COAL.

By W. Mattieu Williams.

In my last I described the usual methods of proving coal by boring, and some of the sources of peril to investors in new ventures. Also the reasons why the deepest part of the seam to be worked is chosen for sinking the pits. I should add that where the coal is near the surface, and the depth of the shafts is consequently small, a larger number of pits are sunk on a given area of land than where the coal exists at greater depths. The reason of this is simple enough. The sinking of shafts is costly, and the cost of course increases with the depth. Also the bringing of the coal from long distances underground to the bottom of the shaft costs more than short distances. Besides this, the work of ventilation becomes more and more complex the greater the area that is worked from one pair of pits. Thus the question of whether a given pair of pits shall continue to be used for winning larger and larger areas, or whether these shall be abandoned and a new pair sunk, is answered by calculating whether the saving that may be effected by shorter underground roads is sufficient to cover the interest on the capital required for the new pits.

The great ten-yard seam of the "Black Country" between Birmingham and Wolverhampton affords an example of numerous pits in proportion to area. This may be noted in passing through by rail. The pits there are not only numerous, but about the most primitive in the kingdom as regards all their appliances.

At Sandwell Park, near Birmingham, where, after many vicissitudes of hope and fear and serious speculations, risings and fallings of shares, a much deeper seam has at last been reached, a remarkable contrast may be observed.

The unsophisticated reader may wonder why I have in the above only spoken of pits, or a pair of pits or shafts, never of a pit or shaft in the singular. The reason is that a single pit or shaft is now illegal in this country. The Corsican butcher called us a nation of shopkeepers, and ignorant outsiders still believe that we, as a nation, sacrifice everything to the exigencies of trade and commerce, but those who choose to inquire and learn the truth will discover that when laws are demanded in which the claims of humanity come in collision with those of profit, British legislation provides for the former at the expense of the latter to an extent unparalleled by the legislation of any other country in the world, either ancient or modern. Our factory acts for the protection of women and children, and the machinery of factory inspectors to enforce those acts; our laws for the compensation of injured workmen, our severe enforcement of compensation for personal injuries on railways, our regulations concerning the loading of ships and the general protection of sailors, our prohibition of chimney-sweeping boys, our laws against using dogs as draught animals, our legislation prohibiting female labour and regulating boy labour in coal-pits, are far more stringent

than those of any other country in Europe. It is purely for the protection of the poor collier that we compel the rich capitalist to sink two pits where otherwise, and in other countries, only one is necessary. As the cost of a pit may amount to ten, twenty, and in some cases to as much as fifty or sixty thousand pounds, this legislative interference with a fundamental industry is one of a multitude of refutations of the shallow Napoleonic libel still repeated by ignorant foreigners.

The object of the two shafts is to secure efficient ventilation throughout the mine, one shaft serving as an inlet for air, the "downcast" shaft; the other as an outlet, the "upcast" shaft. The object was formerly attained by dividing the shaft down the middle by a "bratticing" or perpendicular wall of woodwork. Brattices are still used in other countries, where the saving of rich men's capital is deemed more holy than the saving of poor men's lives. The catastrophe at Hartley, where a vibration or swing of the cage caused it to strike and wreck the brattice demonstrated the danger of this contrivance, and an Act of Parliament justly abolished it.

The diameter of ordinary modern coal-pits is from 8 to 12 feet; some reach 16 feet, and even more. Old pits of 4 to 5 feet diameter still exist, but are now very rare. In this country they are, with a few exceptions, circular. The exceptions are elliptical pits, which are more common in Belgium.

It is Goldsmith, if I remember rightly, who tells the story of an old paradoxical Chinaman who stopped strangers in the street and asked them which are the more durable, hard things or soft. On receiving the natural answer, he opened his mouth and showed that all his teeth were gone, while his tongue remained as waggish as ever. A similar paradox is presented in pit sinking. Within certain limits, the harder the rock to be penetrated the easier and less costly the sinking of a given depth of shaft. The reason of this is that a hard compact rock, such as the hardest among the coal measures, has only to be removed so as to cut through it a shaft of the required diameter. This being done, the rock itself constitutes its own pit wall. But when the rock is soft and friable, such as the shales that abound in the coal measures, an artificial lining wall must be built all round.

In ordinary cases this wall is made of brick. It is evident that the first excavation must exceed in diameter that of the final shaft by double the thickness of this brick wall. As it is unsafe to go beyond a certain depth in friable material without supporting it with this lining, the problem to be solved is that of building a tower of brick from the top downwards. If the ground is not very bad, this is done by first proceeding downwards (say from the compact rock) and making the shaft of the same diameter as or smaller than above. Having reached the depth of a safe stage, this portion is now enlarged sufficiently to allow for bricking, and then, as a foundation on which this brickwork is to be raised, kerbs or courbes*—*i.e.*, stout segments of wood, 4 to 6 inches thick perpendicularly, and the full horizontal width of the intended brick wall—are firmly jointed together, forming a stout wooden ring, which serves as a foundation or floor upon which the circular brick wall is built up until it reaches the finished portion of the shaft above. The bricks used are of good quality, and accurately shaped as segments of the circular wall required. The manufacture of such "wedge bricks" is a regular business, the makers keeping moulds for every required diameter.

But how to sink below this kerb, seeing that the kerb and all the wall that rests upon it must be supported while it is being undermined to build beneath it the next instalment of the tower? Where there is a wooden kerb above, safely resting on compact, reliable rock, this may be done by means of "stringing deals"—that is, planks nailed against the upper kerb or kerbs, and against each other if necessary to join them in a string—the lower end of the string being nailed to the lower kerb, which is thus supported firmly. The sinking then proceeds as before down to another kerb.

The worst of all troubles in sinking is that which occurs when "running ground" is reached, such as a deposit of gravel. This is bad enough when tolerably dry; but when it happens, as it usually does happen, that the gravel deposit is a subterranean waterway, the case is very serious. I cannot better illustrate the nature of this, and the mode of fighting it, than by telling the story of my own experience.

I was engaged as manager of the Leeswood works of the London, Leeswood, and Erith Oil Company. Trouble came upon us, in the first place, by a blow from America. There they "struck ile," and also struck us, their petroleum, distilled by nature, being of the same character as our distilled oil, but better in quality. When I commenced the distillation of this oil its wholesale price, refined, was 3*s.* 6*d.* per gallon, now it is about 7*d.* We could not produce it for less than 1*s.* 6*d.*, if we purchased cannel from our neighbours. When the price of American kerosine fell below this, our retorts and my vocation were superseded. But the company had purchased a lease of land supposed to be rich in cannel, and were sinking to it under the supervision of the late Samuel Blackwell, so well known in the Black Country by his commercial enterprise and his commercial misfortunes, and worthily respected in spite of the latter. He visited the works weekly. We had a good underground working foreman or "steward," whose name, of course, was Jones (the population of those parts consists of men, women, and Jones's, chiefly the latter).

Poor Blackwell's health gave way, he knew that his brain was failing under the pressure of trouble, and that he must presently resign. We were close friends, and he initiated me into the work to be done. I had already followed his instructions, and paid the men, &c., but was not a mining engineer. At last Blackwell collapsed suddenly, and with the help of the faithful Jones I did his work. This would have been easy enough had all gone well; but one night I was called up with the alarming intelligence that the pit had given way; the whole structure of brickwork had sunk some inches; the sinkers had come upon loose ground, and a total collapse was threatened. Either the shaft must be abandoned, or the entire structure so far as it had gone must be suspended from above.

This alternative was no novelty to old hands, though rather startling to myself. Jones was fully equal to the occasion. A broad kerb was made of extra thickness, and this was jammed under the base of the brickwork resting on the "gravel wash," which was firm enough vertically while undisturbed. The kerb was completed, each segment being firmly keyed to its neighbour. Strong beams were then placed horizontally under this, and fully spanning across. Similar beams were laid across the mouth of the shaft, and the top and bottom beams firmly connected by strong iron chains similar to those used for raising the coal, &c. Then the sinking was recommenced, but, as it proceeded downwards, the gravel trickled from the sides of the sinking into the intended shaft, and thus opened out a cavern on all sides far exceeding the diameter of the pit. The deeper the sinking, the greater the diameter of this drift cavity. As nearly as I can remember, about thirty feet of depth was thus worked out. My anxiety was serious, doubtless the greater from lack of familiarity.

When I descended the pit and looked upwards there was a brick tower about 150 feet high, suspended by the chains

* *Courbe* is the French name for this contrivance, and I may tell, in passing, that the Welsh miners use the French word, so far as pronunciation is concerned. How they would spell it I cannot say.

and the timber beams. It was completely undermined to a great distance beyond its base all around, although the drift of the gravel was checked by woodwork. It suggested the old story of the sword of Damocles; a more deadly weapon than a sword was hanging perpetually over the heads of the men as they worked below; a failure of the chains or the beams, or of the ground above, and the whole of this suspended tower must come crushing down, hopelessly burying all.

At last the gravel was fully pierced and solid rock was reached; then a stout kerb was laid, and a double wall, an inner cylinder of brickwork corresponding to the finished diameter of the pit, and another outside of this, leaving a space between all round. This space was puddled with clay, "coffered" as Jones called it, in order to keep back the water, which was especially abundant in the gravel. As the double wall advanced upwards, the space behind it was well and firmly filled and rammed. At last the suspending kerb was reached, and when firmly connected with the double tower below, the suspending apparatus was removed.

The coffering to keep out the water is variously devised. Sometimes "tubbing" is substituted for the above-described. This I understand is more frequently used now than formerly. *Cuvelage* is the French name. A detailed technical description of the various kinds of tubbing would be out of place here. It will be sufficient to state that both wood and iron are used; that "plank tubbing," effecting a result similar to cooper's work, is used; also solid wood tubbing, which, broadly speaking, may be described as a lining of kerbs well wedged and caulked at all their joints to make them watertight. Then there is iron tubbing, formed of cast-iron cylinders, which are let down in short lengths and line the pit. Other iron tubbing is formed of cast-iron segments carefully built in. It is always expensive, the cost amounting in deep and large pits to as much as about 50*l.* or 60*l.* per yard. When substituted for brickwork, it has to support the lining structure above, and must be strengthened accordingly as the depth increases. If coalpits were permanent structures, such iron tubbing would be quite inapplicable, as in spite of brick linings and other devices the iron is gradually corroded by the water, and by the gases from the ventilating furnaces. If, however, it lasts until all the coal within its reach is worked out, this is sufficient.

As two pits must, in this country, be available for the ventilation of every colliery, it is convenient in opening new ground to sink the pair simultaneously. One of the advantages of this is the facility afforded for ventilation during the sinking, as the pits are usually placed near to each other. Man is so constituted that he cannot simply bore a hole in the earth to any depth he pleases and remain therein. He must make arrangements for causing a current of air to rise, and another to simultaneously descend, or he will be suffocated by the exhalations from his own lungs and the earth around. In sinking a pair of pits near to each other this ventilation is easily obtained by descending until the air begins to foul, then driving a horizontal communication and establishing an upcast of air in one pit and downcast in the other. The methods of doing this and of producing, directing, and controlling subterranean air currents generally will be treated hereafter.

We understand the Amateur Photographic Exhibition held by the London Stereoscopic Company in the spring has resulted in a loss to them. This was fully anticipated by the directors when they inaugurated it; and that the Company, in the face of this knowledge, have given the amateur world a second exhibition is, we think, most enterprising, and will undoubtedly be appreciated by amateurs as it deserves. We have no hesitation in saying to those amateurs who may be amongst our readers that, in common fairness, they should reciprocate and make their purchases from the Company. We have seen and can vouch for the quality of the articles supplied.

THE RECENT TOTAL SOLAR ECLIPSE.

AR the most interesting results obtained during the recent eclipse are (1) Tacchini's discovery that the spectroscopic method of observing the sun's coloured prominences shows only the brighter parts of the prominences as they actually exist and as they are seen during totality. He observed the eclipsed sun through a telescope 6 inches in diameter, and noted (as during the eclipse of 1882) the existence of whitish extensions around and above the ruddy flames. Making spectroscopic study round the edge of the sun's disc after the eclipse, he found that the ruddy part—so to speak—the *core* of these prominences, was all that could be seen of them by the spectroscopic method. This discovery seems only explicable by the theory that the ruddy, jet-like portion of the prominence owes its light, and therefore its heat, to the velocity of outrush with which ejected matter passes through the hydrogen and helium already outside the sun, and not to the outrush of those gases themselves in an intensely heated condition. For, outrusting gases brought from a region of great pressure to a region of very small pressure would expand rapidly and be quickly cooled, so that the outlines of the heated and luminous portion would be sharply defined, and would be surrounded by a region not only cooler than the ejected matter, but even cooler than the surrounding atmosphere. On the other hand, ejected matter would travel outwards with diminishing velocity owing to the retarding action of solar gravity, while such portions as returned after reaching a certain height would not only be scattered around somewhat widely, but would reach the sun's surface with less velocity than they had had at leaving it, because of the effects of frictional resistance. Hence, above and around the region of rapid outrush, intense heat, and brilliant light, there would be a region where the hydrogen and helium in the sun's atmosphere would be heated by the rush of matter through it, and would therefore be luminous, but would be less heated than the region of outrush. This exactly corresponds with what Tacchini has discovered.

We should expect, as a further consequence, that the corona would show a gradual diminution of heat with increasing distance from the sun's edge, and therefore a gradual change of spectrum, those spectral lines brought out in the laboratory with high temperatures being shorter in the coronal spectrum than those visible when lower temperatures are employed. This was observed first in the eclipse of 1882. But the observations by Messrs. Turner and Perry, by which, on the present occasion, the results of 1882 were confirmed, must be regarded as of considerable importance, though not altogether new. An attempt has been made to reconcile the observation with the old and exploded theory that the corona is a solar atmosphere; and strangely enough the attempt has been made in the very same quarter where the idea was longest and most obstinately maintained that the corona is not a solar appendage at all. Whatever else we may surmise about the corona, we cannot any longer admit the possibility that it is of the nature of a solar atmosphere properly so-called. Gaseous matter is there in plenty, but it can no more form a solar atmosphere than can the gaseous matter present in the comas and tails of sun-circling comets.

Unfortunately, one of the most important results of the recent eclipse observations has been the complete and final disproof of the solar character of the corona Mr. Huggins has succeeded in showing in photographs of the uneclipsed

sun. We must confess that even the support of Professor Stokes—who is more cautious than Mr. Huggins himself—and of Captain Abney, whose photographic experience counted for much in such a matter, had not seemed to us to render Mr. Huggins's views about these photographed coronas probable, strongly though our wishes favoured the hope that he might be right, after all. Of course, it was not possible to reject Mr. Huggins's photographed corona as absolutely and unhesitatingly as we were forced to reject the fancy of Mr. Brett (the able landscape-painter) that he could actually *see* the corona without the aid of an eclipse! For Mr. Huggins's hopes were based on scientific possibility, viz. that the strongly actinic portion of the corona's light might make its pressure felt where the corona's light as it affects vision is demonstrably too weak to be discerned. Mr. Brett's fancy never had a trace even of possibility. The photographs of the partial eclipse at Cape Town and of phases preceding totality at the West Indian stations, unfortunately dispose finally of the idea that Mr. Huggins had photographed the real corona. For, under conditions far more favourable for showing the solar corona (because of the great diminution of atmospheric glare) the coronal appearances were much fainter, and—an even more decisive blow—no trace of the moon's form could be traced on such coronal streaks as appeared. Undoubtedly if the light around the sun in Mr. Huggins's photographs came really from the solar corona, the presence of the moon would have been clearly indicated in the pictures. The fact that the moon is not thus discernible proves that the coronal appendages seen round the sun belong to a region nearer than the moon—doubtless, therefore, to our own atmosphere.

Good photographs of the corona have been obtained by Captain Darwin and Mr. Schuster, some of them including photographs of the coronal spectrum. The corona's light has been measured by Professor Thorpe; but we do not learn how it was differentiated from the light of that portion of the air above the observer's horizon which was illuminated by full sunlight, even during mid-totality. It seems almost impossible to take duly into account the varying condition of our air in different eclipses, alike in regard to transparency (by which the corona's light is more fully received) and to light-reflecting power (by which more of the light falling on the air comes into play to diminish the darkness of total eclipse).

In reading the very voluminous report of the eclipse observations in the London *Times* a somewhat inexact idea might be conveyed by the circumstance that the results read as if they were due severally to Lockyer and Tacchini (persistently called Zacchini, such is fame!) to Darwin and Lockyer, to Lockyer and Perry, to Schuster and Lockyer, to Lockyer and Thorpe, to Maunder and Lockyer, to Lockyer, and so forth. This will be understood better perhaps when we note that the report is due solely to Mr. Lockyer's well-known reporting ingenuity; the eclipse itself he omitted to see, because at his station "it was not in sight." Only one new method is deemed worthy of special notice by the reporter, Mr. Lockyer's new photographic method, which must be far superior to all others, for he says so. It was bound to be a success. It *was* a success. "Mr. Lockyer," says Mr. Lockyer, "will not hear of want of success; he holds that the problem has been solved." Only one thing was wanting. "No photographs have been actually taken" by this method. Who, however, but a paltry caviller would mention such a mere detail as that? "In spite of the want of photographs . . . the problem has been solved"!

ETHNOLOGY OF THE BLACKFOOT TRIBES.

THE primitive creation is attributed to a superior divinity, whom they call the Creator (*Apistotokin*), and sometimes identify with the sun. After this divinity—of whom their ideas are very vague—had created the watery expanse, another deity, with the aid of four animals, of which the musk-rat was the chief, brought some earth from the bottom of the abyss, expanded it to the present continent, and peopled it with human beings. This deity is commonly styled by them the "Old Man" (*Napiw*), a name implying, as used by them, a feeling of affectionate admiration. He is represented as a powerful but tricksy spirit, half Jupiter and half Mercury. "He appears," writes M. Lacombe, "in many other traditions and legendary accounts, in which he is associated with the various kinds of animals, speaking to them, making use of them, and especially cheating them, and playing every kind of trick." In this being we recognise at once the most genuine and characteristic of all the Algonkin divinities. In every tribe of this wide-spread family, from Nova Scotia to Virginia, and from the Delaware to the Rocky Mountains, he reappears under various names—Manabozho, Michabo, Wetuks, Glooskap, Wisaketjak, Napiw—but everywhere with the same traits and the same history. He is at once a creator, a defender, a teacher, and at the same time a conqueror, a robber, and a deceiver. But the robbery and deceit, it would seem, are usually for some good purpose. He preserves mankind from their enemies, and uses the arts of these enemies to circumvent and destroy them. In Longfellow's charming poem, he is confounded with the Iroquois hero, Hiawatha. In Dr. Brinton's view, his origin is to be found in a Nature-myth, representing "on the one hand the unceasing struggle of day with night, light with darkness, and on the other that no less important conflict which is ever waging between the storm and sunshine, the winter and summer, the rain and clear sky."

A CALIFORNIA TREE. — There was recently felled in Lonoma County, California, a tree which cut up as follows. The *Petaluma Argus* says that the details can be relied upon. The standing height of the tree was 347 ft., and its diameter near the ground was 14 ft. In falling, the top was broken off nearly 200 ft. distant from the stump, and up to the point of breaking the tree was perfectly sound. From the tree saw-logs were cut of the following lengths and diameters:—1. 14 ft. long, 9 ft. dia.; 2. 12 ft. long, 8 ft. dia.; 3. 12 ft. long, 7 ft. 7 in. dia.; 4. 14 ft. long, 7 ft. 6 in. dia.; 5. 16 ft. long, 7 ft. dia.; 6. 16 ft. long, 6 ft. 10 in. dia.; 7. 16 ft. long, 6 ft. 6 in. dia.; 8. 16 ft. long, 6 ft. 4 in. dia.; 9. 16 ft. long, 6 ft. 3 in. dia.; 10. 18 ft. long, 6 ft. dia.; 11. 12 ft. long, 5 ft. 10 in. dia.; 12. 18 ft. long, 5 ft. 6 in. dia. It will thus be seen that 180 ft. of this remarkable tree were converted into saw-logs.

With reference to the obvious idea pervading Mr. Proctor's articles on "Americanisms" in the last number of KNOWLEDGE that the critique in the *Saturday Review* was written by me, may I venture to state that I did not write that paper, that I have not contributed to the *Saturday* for years, that I do not know who was the author, that I supplied no facts or material for it, and that I was ignorant of its very existence till I saw myself accused of having composed it? I have written a full denial of the imputation to Mr. Proctor, and I earnestly trust the misapprehension may not impair a friendship which I value, and have always valued, very highly.—GRANT ALLEN.

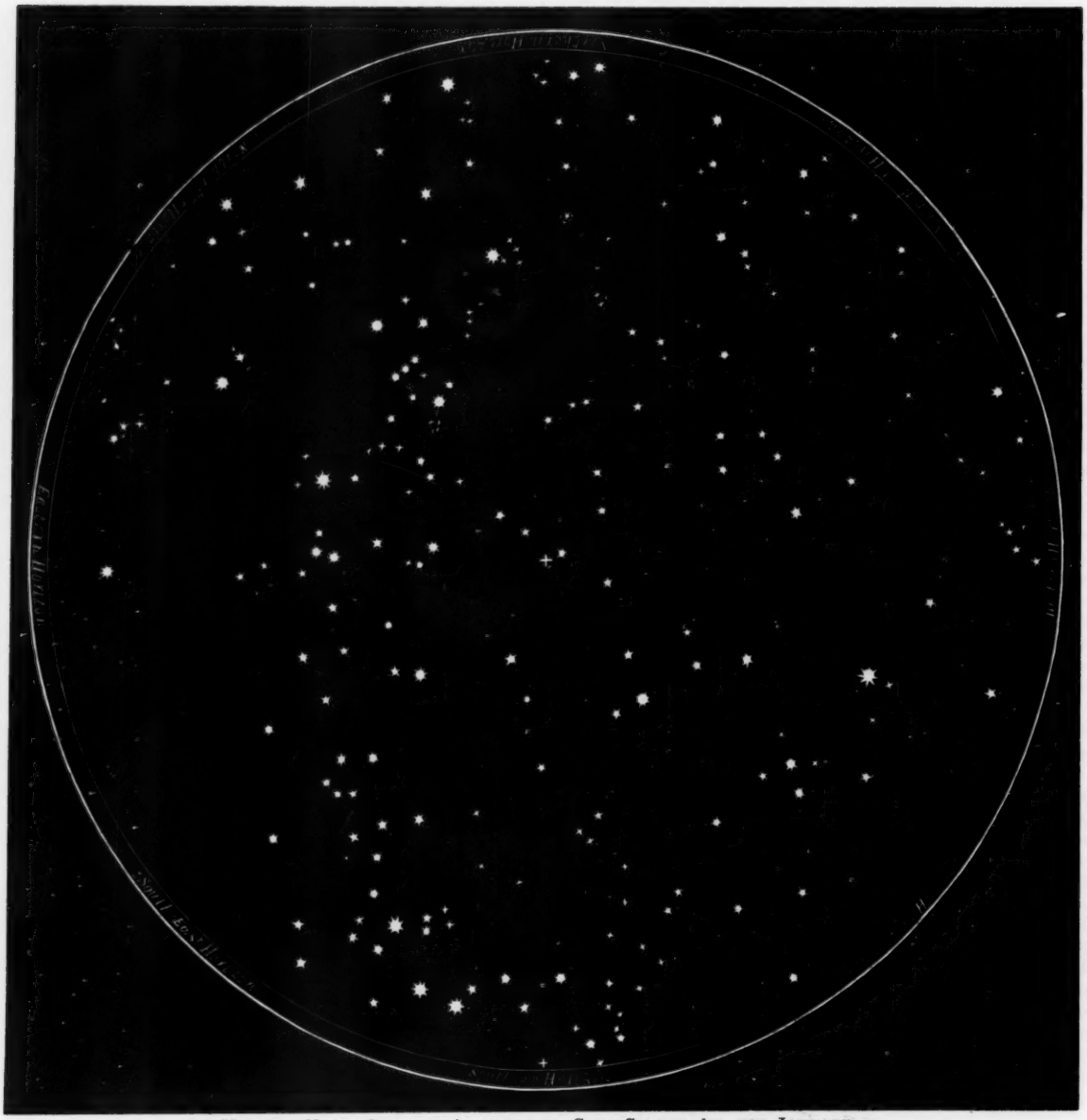
XUM

THE SOUTHERN NIGHT SKIES.

IN the last volume of KNOWLEDGE I began a series of maps of the night skies of the southern hemisphere, intended to show them for each night in the year all the year round. But a series of blunders and delays on the part of the engravers, and the most contradictory misinterpretation of my instructions, prevented me from carrying out my design. Only three maps of the series appeared, and those so late as to be scarcely of any use for the purpose intended.

I now begin the series afresh under more favourable conditions. I propose to present the skies of the southern hemisphere now, for latitude 38° south, or accurately enough for such maps, for all places between latitudes 30° and 45° south, in duplicate. One map will show the stars down to the third magnitude, with a few of the smaller stars when necessary to complete groups, on a black ground without any names or lettering. The other will show the same stars on a white ground, with the names of constellations, Greek lettering for stars, and other writing and lines for guidance. Each paper of the series will appear two months in advance, so as to be in good time for readers in Australasia and Cape Colony. In the first pair, accompanying this, the night skies for January are presented. The maps are for the following hours :—

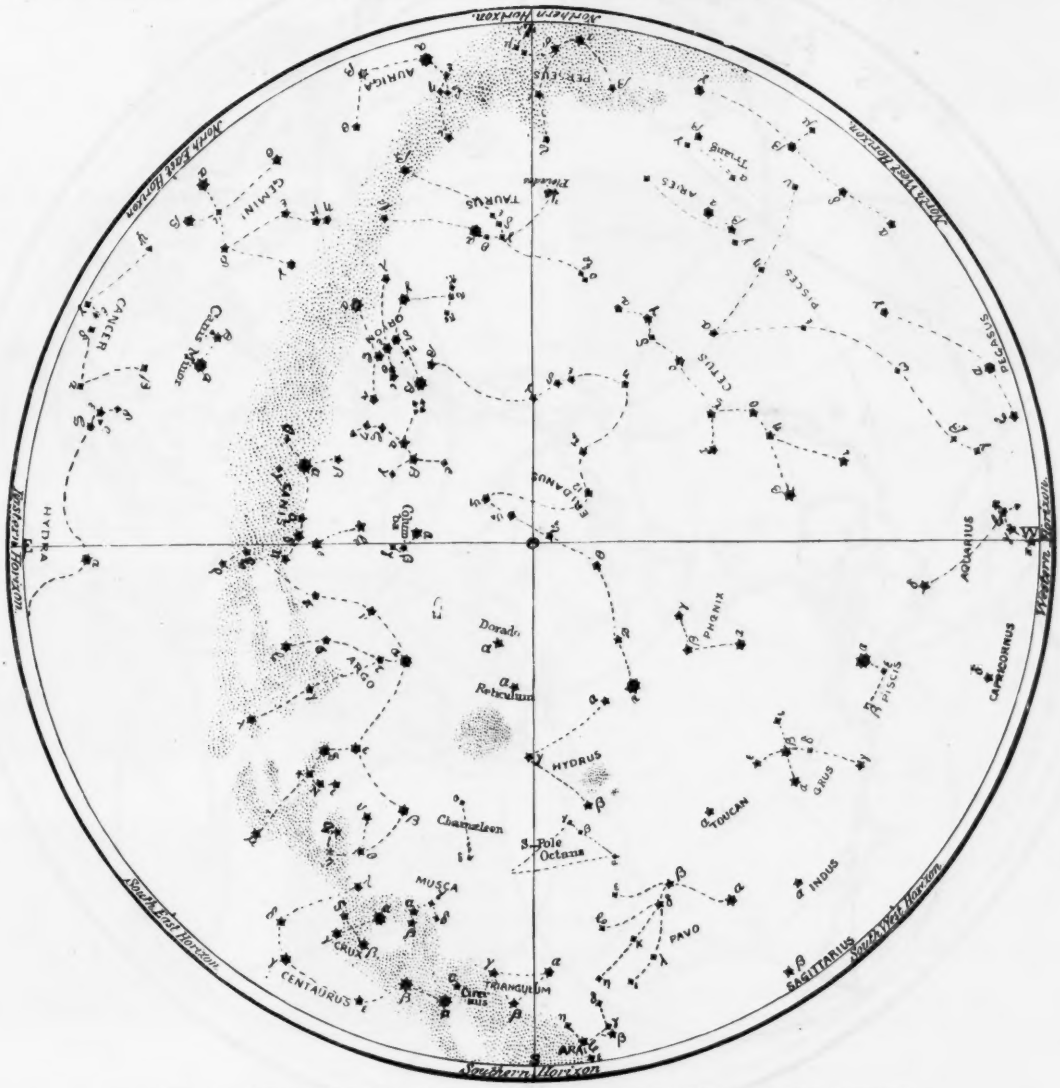
At 10 o'clock, December 23.	At 8¾ o'clock, January 10.
„ 9½ o'clock, December 26.	„ 8½ o'clock, January 14.
„ 9¼ o'clock, December 30.	„ 8¼ o'clock, January 18.
„ 9¼ o'clock, January 3.	„ 8 o'clock, January 22.
„ 9 o'clock, January 7.	



MAP 1*a*.—NIGHT SKIES OF AUSTRALASIA, CAPE COLONY, &C., FOR JANUARY.

To the traveller voyaging southwards the skies which in England lie towards the south at these hours rise higher and higher, till at length those which had been along the horizon from east through south to west lie on a circle passing overhead from east through the zenith to west. The southern half of our English night skies at any hour is the northern half of the skies of latitude 38° south at the same hour, but while our southern horizon stars make an arch overhead with them, their northern horizon stars make an arch overhead with us.

Thus the series of maps which is now commenced will serve, as a moment's study will show, to present our English



Map 1*b*.—Key to Map 1*a*. Night Skies of Southern Hemisphere for January.

southern skies (in the upper half of each map) for every night of every month in the year, the horizontal central line of the map representing the horizon for this use of the maps, while it will show the whole of the sky for the southern hemisphere, the circumference of the map representing the horizon. Turning to the south we find no polar star. (Mr. Hampden says that there is no pole, but mistakes.) The nearest star to the pole in our map is *κ Octantis*, a fifth-magnitude star. Below the pole we see the Triangle (Southern) with *Pavo* (the Peacock) on the right or west, *Musca* (the Fly) and *Crux* (the Cross). These constellations with the pole, *Chamæleon*, the *Reticulum* (the Net), *Hydrus* (the Water-Snake), and *Toucan* (the Toucan), are always visible in the southern region named, being circumpolar. Other south polar constellations are not shown, having no stars higher than the fifth magnitude.

High up in the south-east we see the great ship *Argo*, wrong side up with care. Naturally the sea-serpent *Hydra* is flourishing her mighty length along the horizon underneath the masts and sails of the ship.

Due east is *Canis*, the Greater Dog, high up, and on his back; the Dove, *Columba*, being perched on the Dog's hind feet.

In the north-east we see *Orion* on his head, but he makes nearly as fine a figure if his shoulder stars for our hemisphere are made leg stars for the Southern, and *vice versâ*. *Gemini*, the Twins, stand also on their heads, and by no means suggest the idea of twins.

Taurus is the chief constellation towards the north at

this time, just as from our hemisphere he is the chief constellation towards the south. Of course, it will be understood that the movement of Orion, Taurus, and all these other constellations in the northern skies of the southern hemisphere, is from east to west, or from right to left.

Overhead, the winding streams of the river *Eridanus* extend from near β of Orion to between *Phœnix* and *Hydrus*, where the bright *Achernar* (α Eridani) is seen—a star now too far south to be seen from those places in the northern hemisphere, where it used to be seen in the time when it received its name.

In the south-west quarter of the sky we see the Northern Triangle, *Aries* (the Ram), *Pisces* (the Fishes), *Cetus*, the Sea Monster, and *Aquarius*, the Water Bearer.

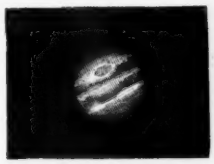
North Polar Index Map.

A UNIFORM ATLAS.

We give this month the north polar index map for the proposed uniform atlas; the southern index map will be given next month, to which occasion (space pressing very much this month) we reserve the explanation of the plan by which we propose to present the whole surface of the globe in twelve equal maps, in which the different parts of the earth will be presented in the same uniform plan and on the same uniform scale throughout.

PHOTOGRAPH OF JUPITER.

THE accompanying photograph of Jupiter, by the Brothers Henry, is full of promise. It was taken on April 21, 1886, and is interesting because of the presence of the great red spot first detected by Professor Pritchett, of Glasgow, Missouri, in 1877, and since carefully and continuously observed by many students of astronomy. MM. Henry remarks that the red spot is more striking



and better defined (*plus nette*) in the photograph than by direct telescopic vision.

OUR PUZZLES.

SOLUTIONS of the three puzzles VII., VIII., and IX. are given under the heading "Mathematical Recreations." I have received other solutions of Problems I. and II. besides those given (one for each puzzle) in KNOWLEDGE for September.

Puzzle I. Nineteen trees may be arranged so as to make nine rows of five trees in the following ways, the first of which is that given as the solution :—

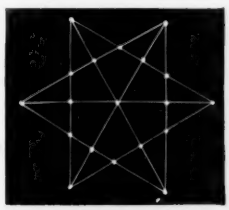


FIG. 1.

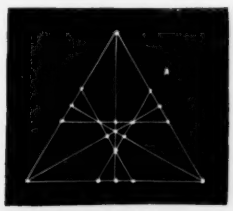


FIG 2

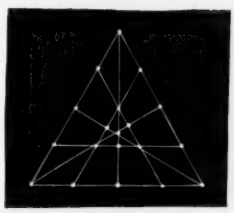


FIG. 3

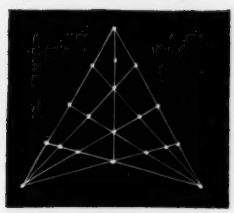


FIG. 4.

These solutions all possess a certain degree of symmetry, and all certainly fulfil the conditions of the puzzle as it reached my hands. I might easily modify the conditions of the problem so that the solution in fig. 1 should be the only one available. For instance, that is the only solution in which the five trees on each row are so arranged that the middle tree is at the centre of its row, and the other four form equidistant pairs on either side of it. But instead of hampering the problem with conditions of detail spoiling it as a puzzle, I will take a bolder course, and replace it with a puzzle of my own invention, and of greater difficulty, thus :—

PUZZLE X. *Arrange nineteen trees so as to make* TEN *rows of five trees in each row.*

Again, six cords may be stretched between nine pegs, or a smaller number, so as to enclose ten spaces in any of the following ways, the first of which is that I gave as a solution :—

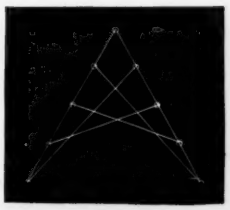


FIG. 5.

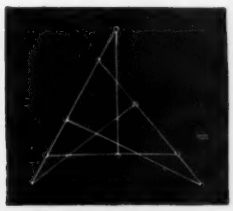


FIG. 6.

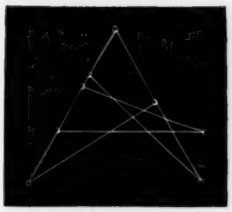


FIG. 7.

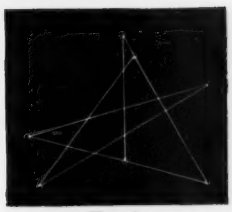


FIG. 8.

Here only fig. 5 is symmetrical, and that only in an axial, not in a central manner. Observe the following distinctions between these four solutions :—

In fig. 5 there are 4 triangles and 6 quadrangles : 9 pegs.

In fig. 6 there are 6 triangles, 2 quadrangles, 2 pentagons : 9 pegs.

In fig. 7 there are 7 triangles, 3 pentagons : 8 pegs.

In fig. 8 there are 6 triangles, 3 quadrangles, 1 pentagon : 7 pegs.

Not one of these arrangements seems to me quite as good as it might be; the arrangements in figs. 6, 7, 8 are altogether unsymmetrical, and that in fig. 5 has only partial symmetry; while there are too many different shapes in all the arrangements. I therefore present in this case also a new puzzle on the same lines, and almost the same cords and pegs—a neater puzzle of somewhat greater difficulty (though the completeness of the conditions really indicates the direction in which a solution is to be found); thus—

PUZZLE XI. *With six cords, fastened to nine pegs, enclose ten spaces of the following forms :—*

First, one equilateral hexagon having equal alternate angles;

Secondly, three equal and similar quadrangles, each axially symmetrical; *

Thirdly, six equal and similar triangles.

As a third problem, which for symmetry's sake shall be closely related to our third puzzle, even as these two are closely related to the first and second, I repeat here a puzzle which was given and very fully solved in the early numbers of KNOWLEDGE by the ingenious "Mogul" :—

PUZZLE XII. *Given a rectangular carpet of any shape and size to divide it with the fewest possible cuts so as to fit a rectangular floor of equal size but of any shape.*

* A figure is said to be axially symmetrical when a straight line can be drawn as an axis dividing it into two equal and similar portions, such that if either were rotated about said axis through two right angles it would exactly coincide with the other. Thus an isosceles triangle is axially symmetrical, the bisector of the angle between the equal sides being its axial line.

XUM

MATHEMATICAL RECREATIONS.

THE interest taken in the quasi-mathematical puzzles which have recently appeared in KNOWLEDGE has suggested the idea that pleasant recreation might be combined with useful instruction in the properties of mathematical curves, figures, and so forth, in a series of papers (not necessarily continuous), to be called Mathematical Recreations.

As examples, I take the three puzzles given in the October number of KNOWLEDGE.

I. THE PARABOLA.—The properties of this curve must of course be studied in treatises on conic sections to be thoroughly understood; but many who do not care to enter into such complete study of the curve as this may be interested to know how they may pleasantly and prettily construct true parabolas, while others who really are students of mathematics will gain clearness of insight into the parabola's properties by constructing the curve in various attractive yet exact ways.

Of all recreative ways of presenting geometrical curves none are so pleasing, either in actual construction or in their effect, as those which show a series of enveloping tangents, as is required in the puzzle on the parabola. I give for the present only methods of this kind. (The curves

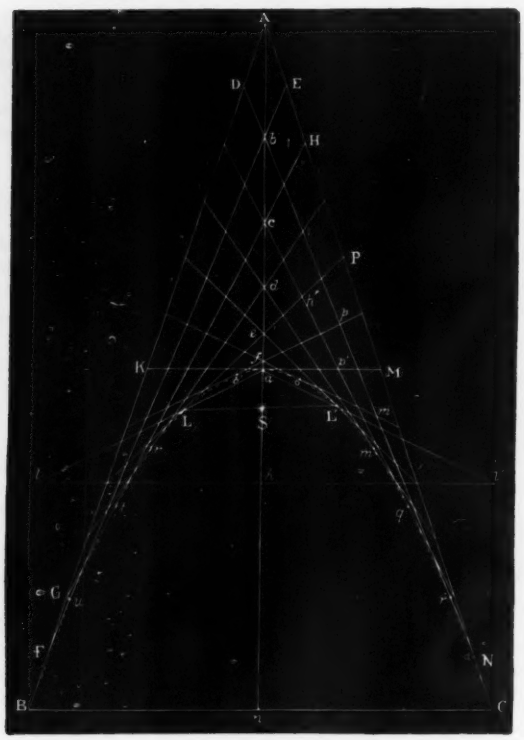


FIG. 1

may be dealt with in other ways, some of which are perhaps in a geometrical sense more effective.) All the conic sections may be represented by enveloping tangents, but the construction for the parabola is the simplest of all.

Draw lightly in pencil on a card, preferably an enamelled white or tinted card—only in this case draw the lines on the unenamelled sides—two straight lines, AB and AC, fig. 1, at some such angle as is shown in the figure. Opening a pair of dividers to any convenient small distance, AD or AE, measure off equal distances along AB and CA as shown. There is no occasion to divide a given line, AB, into a number of equal small parts; simply the measurements go on from A till a point is reached conveniently near B, and then similar measurements are made along AC. There should be the same number of divisions along AB and AC, and the number should be even, for a reason presently recognised. Now pierce fine holes through the card at the division marks, and taking a needleful of fine silk (of any dark colour if the card is white, but if the card has tint then it is best to have the silk of the complementary colour) carry it from B (where it may be knotted on the under side) to A, thence under the card to come out at E and from E to F, thence under the card to G, and from G to H, and so on. If the number of divisions was originally even, you arrive in this way at a line KM, and going on, you finish with the lines DN and CA, completing the series of thwart lines. Each of these lines is a tangent to a parabola having its axis on the bisector of the angle BAC, and the lines drawn as described show the true shape of a parabola very effectively by giving a series of enveloping tangents. You may now draw BC and bisect in n, connecting An with a line of silk. This line bisects KM as at a, which is the vertex of your silken parabola. If your work has been correctly done, all the corresponding tangent lines from AB and AC cross on An.

To mark in the focus of your parabola, the construction indicated in the figure is all that is necessary. Draw any straight line, as lkl', parallel to KM or BC, and take kl and kl', each equal to twice ak. Then drawing la, $l'l'$, you have lines intersecting the parabola at the extremities of the *latus rectum*, LSL′, cutting an in the focus S. These lines of construction should be drawn in pencil, lightly, before the parabola is obtained from its silken envelopes. Afterwards pierce the card at L and L′, and take a silken line LSL′. Around the focus S a little star may be made (with yellow rays) as shown in the figure.

The following features may be noticed:—

(1) Such intersection points as H, h, h', &c., Ppp', &c., lie on lines parallel to An. By an optical illusion, it will be found that if we run the eye from any division point (as H) on AB AC to the series (as h, h', &c.) really lying on a line parallel to An, the idea is conveyed that the line so followed curves inwards towards An.

(2) If we take points P, h, c, &c., or M, p, h', d, &c., running from any division point along AC or AB athwart the other diagonals of the quadrangular divisions, we get a series of points lying on a parabola having its axis in the line An.

(3) The alternate parallels thus obtained are diameters through o, o', L, L′, &c., the points in which the enveloping tangents of our figure touch the parabola.

(4) If we take any point, as o, in which one of the tangents touches the parabola, then a series of lines, aL′, $o'm$, Lq, rr', &c., obtained by joining the successive points of tangential contact on either side of o, will be parallel to each other and to the tangent at o; so that they will be ordinates to the diameter through o.

II. THE ELLIPSE.—This, of all the conic sections, is the least convenient to deal with in the manner we are considering. Here, however, is a construction, the reason and demonstration of which I leave the student to deduce for himself:—

Let CA, CB be the half axes of the ellipse we want to draw. Complete the rectangle CBDA, and the quadrant FDE. Divide BF and AE at G, H, K, L, &c., and P, Q, R, &c., so that

the spaces between the divisions rapidly diminish as shown (no special construction is necessary). Then proceed as follows: Opening a pair of dividers to span CG, keeping the end of one leg at C, mark the point g on BD with the other; then opening to span Bg, and setting the end of one leg at G, mark the point g' on CB with the other; do the like, starting with the span CH, getting the point h'; and so get a series of division marks g', h', k', l', m', n', and o' on CB; dividing AD similarly at G′ (such that DG′=Bg'), H′, K′, &c. Again, opening a compass to span CP, mark the point p on AD, having end of one compass-leg at C, and with span Ap measure off Pp'; do the like, starting from the span CQ, getting the point q'; and so get a series of division marks p', q', r', s', and t' on CA, dividing BD similarly at P′ (such that DP′=Ap'), Q′, R′, S′, and T′.

Now join FE, GG′, HH′, KK′, LL′, &c., PP′, QQ′, RR′, &c. The lines thus drawn will envelop tangentially a quadrant of an ellipse having CB and CA as semi-axes.

If, having carefully made this construction in pencil, we prick off corresponding division marks on the two diameters

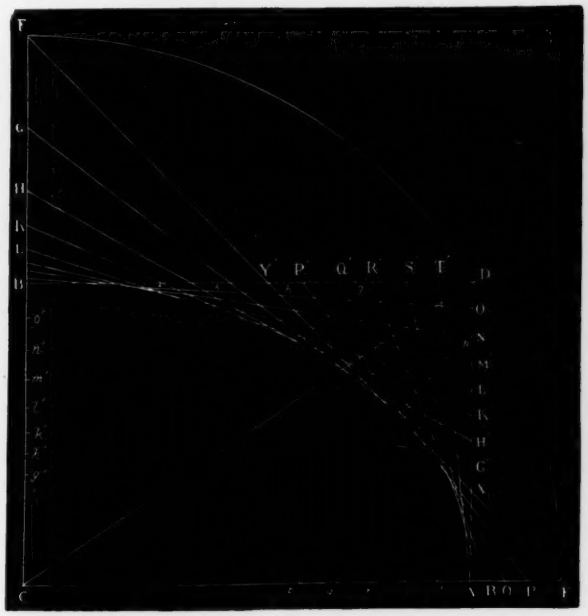


FIG. 2.

of which CE and CF are the halves, and on the four sides of the inclosing rectangle (BD and DA being halves of two of these sides), [prick off division marks corresponding to those on DY, DX (YDX is half a square), we obtain the tangential envelopes of the complete ellipse. The resulting figure has a somewhat singular appearance, the ellipse seeming strangely cut out from within the inclosing circle of which FDE is a fourth.

The same figure may be formed, more quickly, by making two direct tracings of fig. 2, and two inverted tracings (these can be made by turning the figure with its face towards a glass sheet, and tracing from behind by means of the light received through the glass), and combining these four figures into one.

III. THE HYPERBOLA.—There are several ways of obtaining an hyperbola by means of a series of enveloping tangents. Hereafter I shall introduce a prettier and more symmetrical method than that which I present here; but this will serve as a convenient companion to the methods used for the other conic sections.

Let C be the centre, CA a semi-axis, and CD, CD′ the asymptotes of the proposed hyperbola. Along DC take the points E, F, G, nearing each other towards C. Let parallels (not drawn in the figure) through D to D′E, D′F, and D′G cut

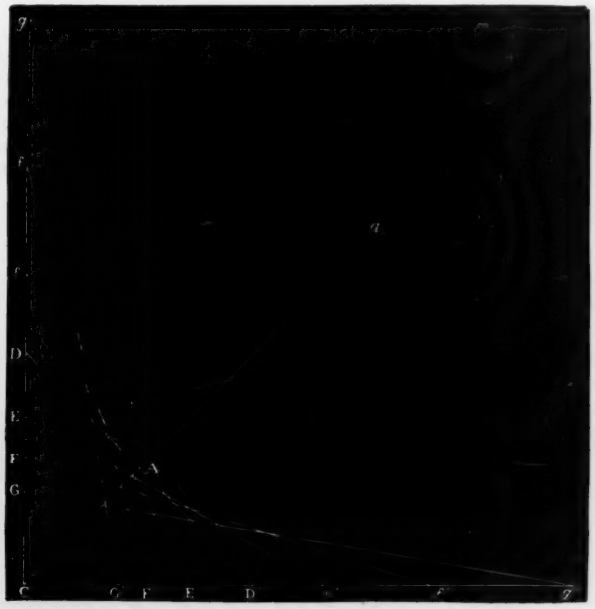


FIG. 3.

CD′ produced in e', f', g'; and make the divisions along Cg and Cg' alike, in the points e, f, and g, G′ F′, and E′. Then join by straight lines gG′, fF′, eE′, DD′, Ee', Ff', and Gg'. These lines will envelop the required hyperbola—that half which lies within the space gcg'. The other half can be similarly obtained.

THE SCHOOLGIRLS' PUZZLE.

THE problem of arranging fifteen schoolgirls so that they may walk out in sets of three, seven days in succession, no two girls being in the same set of three twice, has been rather fully dealt with in Vol. I. (No. 9), Vol. II. (No. 35), and Vol. III. (Nos. 73 and 79—twenty-one schoolgirls to walk ten days in sets of three). The general discussion cannot, I find, be presented in a manner suited to these columns, as considerations of some complexity presently arise. But the following points may be noted in regard to problems of this class.

First, take such a problem as the pairing of an even number of chess-players as in tournaments, where each player is to meet one opponent each day till he has met all, the encounters on each day all beginning at the same time. Or, if we must have schoolgirls in the puzzle, let an even number of schoolgirls have to walk in pairs, day after day, each having a different partner on each day until she has walked with all the rest.

This puzzle or problem can always be very easily solved as follows.

XUM

Calling the several girls A, B, C, D, &c., write down all the combinations of the set, in pairs, in order thus :—

AB, AC, AD, AE, AF, &c.
BC, BD, BE, BF, &c.
CD, CE, CF, &c.
DE, DF, &c.
EF, &c.
&c.

Then repeating the first row, write under it in succession such of the pairs of the second, third, fourth, &c., rows in succession as can walk with the pairs in the first row. Do the like with the pairs in the third and other rows, always putting in the next available pair on a row in the first available place, and filling up according to the requirements for each day's walk, that is, so that every girl may go out each day. The result is bound to come out right.

Thus, suppose there are eight girls, A, B, C, D, E, F, G, H, then the lists come out as follows :—

1st day.	2nd day.	3rd day.	4th day.	5th day.	6th day.	7th day.
AB	AC	AD	AE	AF	AG	AH
CD	BD	BE	BF	BG	BH	BC
EG	EH	CF	CG	CH	CE	DG
FH	FG	GH	DH	DE	DF	EF

But although this method always solves the problem satisfactorily, there is a more systematic plan worth knowing. It was given by Mephisto in Vol. III. of KNOWLEDGE (No. 71). The solution for the case we have just been dealing with is shown in the following figure :—

	A	B	C	D	E	F	G	H
A	—	1	2	3	4	5	6	7
B	1	—	3	4	5	6	7	2
C	2	3	—	5	6	7	1	4
D	3	4	5	—	7	1	2	6
E	4	5	6	7	—	2	3	1
F	5	6	7	1	2	—	4	3
G	6	7	1	2	3	4	—	5
H	7	2	4	6	1	3	5	—

Here the letters represent the eight girls, the seven days on which they are to walk are indicated by the numbers, and a number on any row and column signifies that on the day bearing that number the two persons represented by the two letters marking that row and that column are to walk together. Thus those squares running diagonally across the figure which mark severally a row and a column belonging to the same person remain, of course, unnumbered. The numbers on the first row and column are 1, 2, 3, 4, 5, 6, and 7, showing that A is to walk on the seven successive days with B, C, D, E, F, G, and H. Next, according to Mephisto's way of presenting the method, write in along the second row and column the numbers in order from 1 (at the left and top respectively), omitting the square which is to be left vacant, and setting the number 2, which would have fallen on that square, on the last row and the right-hand column respectively. We do the same with the third row and column, setting the omitted figure, 4, over to the bottom and to the right; and so on to the end. We thus complete a schedule, which would arrange the girls as follows :—

1st day.	2nd day.	3rd day.	4th day.	5th day.	6th day.	7th day.
AB	AC	AD	AE	AF	AG	AH
CG	BH	BC	BD	BE	BF	BG
DF	DG	EG	CH	CD	CE	CF
EH	EF	FH	FG	GH	DH	DE

The *rationale* of this method is obvious. Omitting the H row and the H column, and supposing the vacant squares occupied by the numbers left out in the actual solution, we see that the successive rows may be supposed to be obtained by shifting the preceding row one square to the left and carrying the square thrust out in this way on the left over to the right. This, of course, ensures that every number will fall in succession opposite each letter both on row and on column, so that, applying the result, each person of the set, whether of schoolgirls or of chess-players, will be paired against every other in succession. The same result may be obtained more conveniently, however, as follows :—

A	1						
B	2	3					
C	3	4	5				
D	4	5	6	7			
E	5	6	7	1	2		
F	6	7	1	2	3	4	
G	7	1	2	3	4	5	6
	A	B	C	D	E	F	G

Here we have only seven letters, but interpreting the numbers as in the other method, we see that on certain days we get AA, BB, CC, &c. Introducing in each case an eighth letter H, for the second member of these doubles, and taking the columns in order from left to right, we get the following arrangement :—

1st day.	2nd day.	3rd day.	4th day.	5th day.	6th day.	7th day.
AH	AB	AC	AD	AE	AF	AG
BG	CG	BH	BC	BD	BE	BF
CF	DF	DG	EG	CH	CD	CE
DE	EH	EF	FH	FG	GH	DH

the same arrangement as before. This plan is not only easier and simpler, but it serves better, I think, to indicate the principle on which the method depends. We see that each number representing a day *must* come in four times, and must get a different pair of letters for each time it appears. Take, for example, the 6th day, and begin with the 6 in the first column, which gives us the pair AF; the next 6 being one to the right and one above takes the pair BE; the next takes the pair CD; and we see that the remaining 6 corresponds to GG, and so gives the pair GH. We can also see why the number which in the other way of working this method would fall on the square to be left vacant is carried over to column and row belonging to the eighth letter.

My plan is also convenient because the same figures may be used for all cases. Suppose the first seven lines above only shown, and that the first column is continued by running on the letters in order, the other columns by

running on the numerals, fresh columns being added at the right, then by setting a strip bearing the letters A, B, C, &c., as in the lowest row of the figure above, at whatever distance from the top the number of schoolgirls or chess-players may require, we have at once the solution for that number.

The number of letters in this method will be odd, and the letter afterwards added making the total number even. Obviously, if the total number is $2n$, there will be n pairs each day, and $(2n-1)$ days of different arrangements.

With regard next to the fifteen schoolgirls. In the numbers above referred to several methods are given for dealing with problems of the kind, where the division is into sets of three. But the 15 may be dealt with thus :—

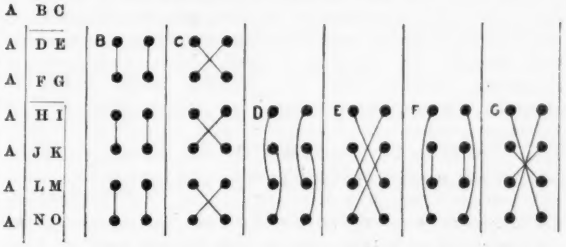
We require all the 15 to go out, each day, in threes, for seven days. There will thus be 35 sets of three, no two of one set being found in any other. If we can find such 35 sets, we shall have solved the problem, for it will then be easy to take these sets five and five, each five containing all the 15 girls. This being so, we might solve the problem by a hammer-and-tongs method—writing down all the 455 combinations, and then selecting 35 fulfilling the condition indicated, and arranging these as required. Thus our sets of combinations and our work of sifting out would begin like this—

Combinations.	Number.	No. Taken.
ABC, ABD, ABE, ...ABO	13	ABC
ACD, ACE, ...ACO	12	none
ADE, ...ADO	11	ADE
.....	...	...
AMN, AMO	2	none
ANO	1	ANO
	91	7
BCD, BCE, BCF, BCG .....BCO	12	none
BDE, BDF, BDG .....BDO	11	BDE
BEF, BEG .....BEO	10	BEG
BFG .....BFO	9	none
.....	...	...
BMN, BMO	2	BMO
BNO	1	none
	78	6
CDE, CDF, CDG, CDH .....CDO	11	CDG
CEF, CEG, CEH .....CEO	10	CEF
CFG, CFH .....CFO	9	none
CGH .....CGO	...	none
.....	...	...
CMN, CMO	2	CMN
CNO	1	none
	66	6
DEF, DEG.....DEL, DEM.....DEO	10	none
DFG.....DFL, DFM.....DFO	9	none
.....	...	...
.....DHL, DHM.....DHO	7	DHL
.....DIL, DIM .....DIO	6	DIM
.....DJL, DJM .....DJO	5	DJN
.....DKL, DKM.....DKO	4	DKO
.....	...	...
..... DNO	1	none
	55	4

And so on to the end. (I have given the D combinations more fully than the others, to show how as the end draws near the combinations available have to be sought further along the rows.) Proceeding in this way we get the following 35 combinations :—

ABC						
ADE	BDF	CDG				
AFG	BEG	CEF				
AHI	BHJ	CHK	DHL	EHM	FHN	GHO
AJK	BIK	CIJ	DIM	EIL	FIO	GIN
ALM	BLN	CLO	DJN	LJO	FJL	GJM
ANO	BMO	CMN	DKO	EKN	FKM	GKL

These thirty-five combinations can be obtained more conveniently, however, by a method which was suggested in KNOWLEDGE, Vol. I. (No. 9). (I fear the volume is out of print.) The following is a simplified explanation. The plan depends on putting down first all the available combinations beginning with A, viz., ABC, ADE, AFG, AHI, AJK, ALM, ANO ; then taking the fourteen letters without A, and out of them making all the available combinations beginning with B and C, six of each ; then those beginning with D, E, F, and G, four of each. The best way of doing this is illustrated in the following figure, where the dots stand for the letters similarly situated in the A column :—



This gives the same arrangement as before. (The arrangement should be compared with the above figure, when any difficulty as to the interpretation of the dots will be at once removed.)

If we now make sets of fifteen out of these combinations of three, we do not at once get the arrangement required ; but each trial requires only a few minutes, and there are not more than three or four cases to be dealt with. We presently obtain the following arrangement :—

1st day.	2nd day.	3rd day.	4th day.	5th day.	6th day.	7th day.
ABC	ADE	AFG	AHI	AJK	ALM	ANO
DIM	BLN	BMO	BEG	BDF	BHJ	BIK
EJO	CHK	CIJ	CLO	CMN	CEF	CDG
FHN	FIO	DHL	DJN	GHO	GIN	EHM
GKL	GJM	EKN	FKM	EIL	DKO	FJL

In like manner other cases can be dealt with where sets of three are in question. The numbers of KNOWLEDGE above mentioned contain general rules and methods for such cases.

The problem relating to the sixteen whist-players, who are to sit down at four tables on five successive evenings, so that no two shall play twice in the same set of four, was of my own invention. When I set it I had not solved it, but I knew on general principles that it must admit of being solved. It has proved a trifle tougher than I expected, but is not very difficult. I defer the solution for a month, because I find that it depends on another problem relating to sets of three, which may be thus presented :—

PROBLEM.—*How may twelve schoolgirls go out three and three on four days, and then four and four on a fifth day (or twelve whist-players play single dummy four days and the full game on a fifth day, each day retaining their places unchanged throughout), in such a way that no two will twice belong to the same set whether triplet or quadruplet ?*

The solution of this problem, as well as that of the problem of sixteen whist-players, will be given next month.

XUM

NOTES ON AMERICANISMS.

By Richard A. Proctor.

THE amazingly and amusingly false assertions in the *Saturday Review* about my "Notes on Americanisms," and especially the statement (wittingly untrue, I fear) that I was writing on a subject, in this case, which I had not studied, were, of course, corrected, for all who know anything about America, by the blundering sequel, in which the critic mistook at least four of every five phrases which he undertook to explain. But it occurred to me at the time that I might present evidence from my note-books of travel to show that American talk had received more than a mere passing attention from me during my widely ranging travels through the United States and Canada. On referring to my notes, however, I found that they were scarcely suited for such use, as the talk quoted ran for the most part into mere scraps—useful enough in forming a glossary, but not worth separate quotation.

One case, however, seemed an exception. I found a fairly connected conversation recorded (the morning after it was heard) which not only illustrates one class of American talk among the uncultured, but also a peculiarity of American manners—viz. the freedom with which in America the ubiquitous "lout" is allowed to annoy and interrupt persons who are unfortunate enough to be near him. In places like the theatre, the concert-room, and the lecture-hall a noisy or ill-mannered neighbour is objectionable even to a man who cares nothing for class distinctions. In America one can never be quite sure that, instead of the play or music or lecture one has paid for, one may not have to endure the foolish chatter or the offensive manners of some boor who has apparently come in for no other purpose but to annoy his neighbours. In the old country, I know, such a boor may find admission among respectable persons; but if he will not behave properly he will quickly be shown the way out. It is otherwise in America. Freedom seems to include the right to annoy every one within sight and hearing, just as much as any boors present may see fit. At least, I have often seen a company enduring the misconduct of such folk with only muttered complaints; and I have never seen even the most offensive person turned out.

Occasionally an experience of this kind has its amusing aspect. Instead of a play one may have a farce, which, though not precisely what one has come to hear, may be almost as entertaining.

I was amused, for instance, in this way, for a while at least, one evening in 1880 at Haverley's Theatre, Chicago, where I had gone to hear Paola Marié in the part of Serpolette. Two men sat behind me, who could scarcely have come to hear the "Cloches de Corneville," as neither of them understood a word of French or listened to a note of the music. They were accompanied by a quiet-looking Frenchwoman, of middle age, who had probably come there expecting a pleasant evening in listening to her clever countrywoman on the stage. If that was her hope, I fear she was disappointed. Her companions, of whom she seemed heartily ashamed, talked rambling nonsense nearly the whole time—nonsense dreary enough in the recital, though it amused me at the time, even in the midst of my annoyance at the loss of Mezières' good acting and Paola Marié's good acting and singing.

Here is the record of their conversation, as made at the time. It is not quite continuous, for occasionally they went out ("to see a man," as they explained to their companion), and sometimes I was able for awhile to fix my attention wholly on the stage, even while they talked. For convenience I call them P. I. and W. I.—for Partly Inebriate and Wholly Inebriate:—

P. I. "Them gals in tights is having a deal of chin-play."

W. I. "What in Hades" (he was more monosyllabic) "is it all about, any way? (*A pause.*) That little one ain't got no manners—not to *say* manners—she ain't."

P. I. "You bet she ain't."

W. I. "She's another fraud. Why in h— don't they get one that can act like a lady *should*?" (Paola Marié was impersonating Serpolette charmingly while thus appreciatively criticised.)

Exeunt P. I. and W. I. to "see a man," as they explained to the lady. It is customary now to say that the man is "the person who dispenses cloves"; but if my two philosophic friends had called on such a man, his cloves must have been of inferior quality, for the smell of whisky which diffused itself around them was not perceptibly tempered by any foreign aroma. They had become more solemn than before. In fact the amusement they gave me resided as much, I suspect, in the melancholy gravity of their demeanour and the solemnity of their nasal tones, as in what they actually said:—

W. I. (*Apparently continuing a philosophic discussion.*) "A man only knows what he learns. . . . Yes, *sir*. . . . Yes! . . . a man has to learn if he wants to know."

P. I. (*As one suddenly enlightened.*) "Thet's *so*."

W. I. "Yes, *sir*. You may bet your bottom dollar on that. . . . It's *so* (*a pause as of profound mental labour*). Yes, *sir*. A man has to learn what he knows. . . . A man ain't got to care what Bob Ingersoll says; nor yet what Moses says; nor what Beecher says. He's got to find it out for himself. . . . It's so with every man. . . . He may be bald like that old coot over there (*pointing*), or be as thick of wool as a nigger—or he may be grey—or brown—or black haired. . . . I don't care (*reflectively*) if he's tall or short—or if his eyes is blue or black or grey. . . You bet it's all one. . . . He's got to find out all he knows." (*Hiccoughs.*)

P. I. (*Taking advantage of a pause in the sluggish flow of the other's eloquence.*) "*Say*, old man, let's have another drink."

W. I. "Not now, I won't. I'll drink when I want to, not else" (*angrily*).

Woman (*gently*). "Sh—sh! you distarb ze peoples."

W. I. "I don't care a lamb's mother (one of the monosyllabic kind) for ze peoples. I didn't ask them to come—and (*gloomily*) I don't care a curse* how soon they go."

P. I. (*After a pause, during which he seemed to eye W. I. rather doubtfully, as if thinking he might by chance have taken one drop too much.*) "What are they laughing at now?"

Just here there had been the usual by-play on the stage. Serpolette pulls the pen from behind the Notary's ear, who exclaims: "*Ne me déplumez pas, mademoiselle; ne me déplumez pas!*"

W. I. "If they'd talk in English we should know what it was all about. How much is there of this thing any way?"

W. I. tries to recall the subject he had been dealing with before. Remembering it suddenly, he resumes.

W. I. "Well, I was a-saying as every man has to learn all he knows. I remember I was down in Iowa once—down in Iowa I was—and I met a man there—a Buckeye. Yes, sir, he came from Chillicothe, Ohio. I had thirteen thousand dollars, greenbacks—and he had fourteen thousand in bonds. Well, sir, we got a-talking about jest this pint of philosophy, and he says, 'Bloss,' he says—that's my given name, Bloss

* Here the well-read reader recalls at once Chaucer's "He sette not a kers." Our "curse" used in this way is simply a profane corruption for the old English "kers" for "cress;" "he cared not a cress," "he recked not a rush," and so on.

is; the other's my other name, but Bloss is my given name —'you know me, don't you?'" (*doubtingly*).

P. I. "You bet I do."

W. I. "Well, I was a-saying. This Buckeye, he says, 'Bloss,' he says, 'a man has to pay for what he learns. And you bet thet's so. Every man has to pay. I don't mind who he is. Every man has to pay just the same! (*A pause for further reflection on this point.*) . . . And if he's a fool he has to pay a damd sight more."

P. I. "Thet's real true—yes, sir, thet's so."

W. I. "You bet it is. I don't care what a man has. He may have five dollars or five hundred thousand—it comes to just the same. Now this man (*pointing at me, or in my direction*), he mayn't know what a hundred dollars is."

P. I. (*enthusiastically*). "Thet's *so*."

W. I. "No, sir (*dreamily, having apparently lost the thread of his discourse, which was unfortunate, as he had not made much progress so far*). He doesn't know anything at all about it. . . . Some men never earned a dollar in their lives. I despise that lot . . . I don't mind what a man has, so he's earned it. . . . Not if he ain't nary a cent. . . . What is it Burns says? 'A man's a man, if he's only in a nutshell, and eh that, and eh that'" (a quotation not generally known; I give it as he gave it). "Yes, *sir*—'a man's a man for eh that.'"

P. I. "You bet." (*In a subdued voice, as of one moved by a solemn truth*).

. . . . . .

W. I. "What are all them gells about now?—them in tights? What *are* they anyway?"

P. I. "I saw some like them at the op'rer a month ago. They called them paggies (query, pages?) in the bill; but these don't seem quite right."

W. I. "Paggies! (*thoughtfully*). . . . Is that so? (*A pause; then still more thoughtfully*) I *want* to know."

. . . . . .

W. I. "This is all durned rot. That would do for a joss-house" (referring to the phantom scene).

P. I. "Shall we go?"

W. I. "I guess we've had about enough."

P. I. "Shall we go, marm?"

WOMAN. "I shall be vell content."

They rise to go.

MYSELF (*sotto voce*). "Thank Heaven!" (*Music suddenly ceases.* W. I., with a drunken man's keen hearing, catches my words, and resents my pious aspiration.)

W. I. (*suspiciously*). "Stranger, what are you a-thanking Heaven for?"

MYSELF (*blandly*). "For all mercies, past, present, and to come—or go, as the case may be."

W. I. "I don't know so much about that."

MYSELF. "About thanking Heaven?"

W. I. "A man may thank Heaven. So he may."

MYSELF. "So I should imagine."

W. I. (*effusively*). "Say, stranger! Won't you smile?" (I had been smiling unremittingly; I could not help it. But in America "smiling," "seeing a man," and "liquoring up" are all one.)

MYSELF (*anxious not to lose Mézières' fine acting, and therefore turning to stage*). "No, thank you. I have left off smiling for to-day."

Exeunt slowly W. I., P. I., and Woman, W. I. saying meditatively, as he passed from behind me, "I don't quite make that stranger out. He seems to me sorter ambiguous like."

P. I. "Here's your hat."

W. I. "Thet's so" . . . (contemplating it as one might contemplate a long-lost friend) . . . "Yes, sir, that's my hat."

WOMAN. "An' your gra' coat."

W. I. (*same business*). "Yes; that's my overcoat."

If the reader is half as weary of my wholly and partially intoxicated friends, and the nonsense they talked, as I was, he will appreciate the possibilities of annoyance in an American theatre. Yet not one of a score of persons around who lost the performance they had come to see, through the ignorance and stupidity of these two louts, addressed any remarks to them, or made any suggestion as to their withdrawal.

I may remark that the word "paggies" is here interpreted as I suppose it was meant. Pages are not very familiar in the Western States, and I suppose one of my louts, seeing the word "pages" in a playbill, and conscious that the pages of a book were not referred to, concluded that some foreign kind of servitors were meant, and that the word was to be pronounced with a hard "g" to distinguish it from printed pages. But one is apt to make mistakes about such matters, and my friend's "paggies" may have meant something else.*

Next month my "Notes on Americanisms" will be continued in glossary form.

BIRTH OF THE SUN.

TO the legends of the sun-god's birth referred to in the last three numbers many others might be added. In fact, there are innumerable stories of the same kind, relating to the birth and babyhood of sun-gods, or solar heroes, or persons who (long after their death) were regarded as divine, and therefore as necessarily distinguished by all such attributes as ancient solar religions had assigned to the God of the Day and of the Year. In the old world, as well as in the new, the same ideas naturally arose, and were as naturally extended to persons who had been distinguished during their lives as teachers or as legislators, and around whom after their death traditions belonging to far earlier days came naturally to cling. Let these examples, however, suffice.

Before leaving the consideration of the circumstances attending the birth of the sun-god, one point remains to be noticed. It would be natural, of course, in the history of the birth of the actual sun-god—whether as born at morn (the dark cave of night being his birthplace), or as born at the opening of the year in the midst of the dark and cold cave of winter—that the glory of the sun should be mentioned. This in the account of persons regarded as divine, and therefore as showing the signs of the godhead visibly, would suggest naturally the idea of a bright light surrounding the child at its birth. All lesser lights also would disappear in the presence of this more glorious illumination. The disappearance of the lesser lights has been regarded as explaining the idea of the slaughter of other children by the tyrant Kansa, in order that Crishna, whose future power had been predicted, should be destroyed also. In the case of nearly every solar hero, and also in the case of many persons more or less historic to whom solar characteristics were afterwards assigned, we find the same idea, either as a story relating to a decree for destroying other children born at the

* There is an odd example in "David Copperfield" of a correctly noted but misunderstood oddity of expression—at least so I imagine. Barkis, talking of young Copperfield, speaks of him as a "young Rocshus," "by which," says David—that is, Dickens—"I think he meant prodigy." It seems likely that Dickens had heard the expression, just as he had heard "Mawther," when at Yarmouth, and supposed it to be Norfolk dialect, quoting and explaining it in the same way that he explains words really belonging to Eastern Counties' talk. But probably, whoever used the word in Dickens's hearing, as Barkis is made to do, meant "young Roscius." At about the time when "David Copperfield" was written the "young Roscius" was talked about all over England.

XUM

same time, or in reference to measures taken to destroy by exposure or otherwise the child itself whose predicted power was feared. In one or other form the idea appears in every solar story, and in all solarised biographies—if I may be allowed, for convenience, to coin such an expression. As regards the bright light attending the birth of the solar hero, or of the solarised teacher or legislator, we have a number of curious illustrations.

When Crishna was born, his mother became resplendent (remember here how the rays of the rising sun at the winter solstice shone full upon Virgo). The whole cave was splendidly illuminated, says the Vishnu Purana, "the quarters of the horizon were irradiated with joy—the spirits and nymphs of heaven danced and sang, the clouds emitted low, pleasing sounds." Beal, in his "History of the Buddha," relates how, according to Buddhist traditions, when the Saviour of the world was born, "a divine light diffused itself around his person, the Blessed One being heralded into the world by a supernatural light." Zoroaster, the great teacher, of whom later it was found that he sprang from an immaculate conception by a ray of divine reason, was no sooner born than the glory arising from his body enlightened the whole room, and he laughed joyfully at his mother (Laughter and Light were and are closely associated in the oriental mind). The legends of the Hebrew patriarchs relate that at the birth of Moses a bright light appeared and shone all around him; his subsequent adornment with "horns" or rays will be remembered by all readers of the Greek and Latin versions of the Old Testament.

In early Christian art we find the same idea associated with the birth of Christ. The gospel, however, in which the event is recorded, is no longer regarded as canonical. Indeed, nothing but an amazing intensification of Augustine's power of believing, *because* a matter was beyond belief ("*Credo quia incredibile*," he said), would enable men to accept the Protevangelion. Thus does the story run in that apocryphal gospel:—When Mary and Joseph were still three miles from Bethlehem, and "in a desert place," Mary said to Joseph, "Take me down from off the ass, for that which is within me mightily presses me." Then he took her down from off the ass, and found there a cave and put her into it. He went towards Bethlehem for a midwife, and brought one back with him. As they neared the cave a bright cloud was seen over it. "But on a sudden the cloud became a great light in the cave, so that their eyes could not bear it."

It is noteworthy that Tertullian, Jerome, and other of the Fathers state that Christ was born in a cave, and add that "*the heathen celebrated, in their day, the birth and mysteries of their Lord and Saviour Adonis in this very cave near Bethlehem!*" Canon Farrar appears to lean to the idea that the old tradition was right, and that "the actual place of Christ's birth was a cave," the same which "used to be shown as the scene of the event even so early as the time of Justin Martyr (A.D. 150)"—a dangerous doctrine, one would suppose.

Under the very appropriate title of "The Handy Map of the Moon," Messrs. Horne, Thornthwaite, & Wood have just brought out a platinotype reproduction of a large chart of our satellite, drawn by Mr. T. K. Mellor, F.R.A.S. The image of the moon in this capital map is about 11·4 inches in diameter; and the names of something like three hundred of the principal formations are legibly and conspicuously written against them upon it. It would be difficult to devise anything more useful and convenient for reference, by the light of a lantern, to the young working selenographer, inasmuch as not the slightest crowding or confusion is perceptible in any part of the map.

THE NATURALIST'S LABORATORY.

Contribution IV.

IN continuation of the subject of suitable illuminators for the laboratory, we have yet to discuss the various forms of gas lamps and burners of the most approved types.

As to the gas itself, many important inventions have been instituted in recent years to economise in consumption and to increase in illuminating power. Many of the bye-products of distillation which are lost during the process of manufacture of the gas are of the first importance when the intensity of its light is taken into consideration, and lamps have been constructed to restore the naphthalene in the case of the well-known albo-carbon burner, whilst the so-called similar "carboleine" is made use of in Weston's patent "Omega" and the "Carburetter Lamp." By these means considerable saving is effected; as much as twice the illuminating power is produced at about one-third of the original expense. It is well for those who use gas also to know of the existence of governors for regulating the pressure of supply to the domestic pipes, as such variations cannot always be avoided in the gas mains. Undoubtedly the best form of apparatus in the market is that called after its inventor, the "Stott" self-acting gas valve. The object of this invention is to prevent over-pressure and the consequent waste therefrom. The *modus operandi* is:—Any excessive pressure immediately acts on an inverted cup, sealed in an annular trough filled with quicksilver. To the centre of the inverted cup is attached a spindle, at the bottom end of which is a double-beat valve, a high pressure raising the inverted cup, and thus closing the valve, while a low pressure allows it to fall, thus opening it; for instance, if 50 out of 100 lights be turned off there will be a corresponding increase of pressure on the inverted cup, raising and thereby closing the valve partially, so that for every light turned off or on, or any increase or decrease at the street mains, there is a corresponding opening or closing of the valve in the governor, the pressure at the burner thus being the same under any circumstances, and the result being a saving of from 10 to 30 per cent., varying according to the pressure at which the gas is supplied to the consumers.

The form of the gas-burner is said by Dr. A. Vernon Harcourt to have added in the cases of the fishtail, batwing, and Argand types, "as much as 20 or even 50 per cent. to the light obtainable or commonly obtained from a given consumption of gas. To produce a steady and brilliant flame the gas must issue in a slow stream and spread into a sheet, fan-shaped or cylindrical, of suitable thickness, so that the hydrocarbons may be decomposed by heat and partial combustion along the central plane, and the resulting smoke may continue to burn and glow as it spreads outwards for as long as is consistent with the development of a sufficiently high temperature, and then may meet the outer air so suddenly and over so large a surface as to be completely consumed."

Burners are also made by means of which heated air is supplied to the flame, as already alluded to, in order to increase its illuminating power. It has been found that the ordinary gas-burner in general use does not provide sufficient heat for the ignition and complete combustion of the carbonated gas, so that a waste of material results, and with the loss of light the atmosphere becomes polluted by the products of combustion added to by liberated free gas, and thus the apartment is liable to be filled with a noxious element and a powerful anæsthetic—conditions which operate directly to make one drowsy and weak. To

effectually prevent both of these evils, and to gain fresh light, Dr. Sir William Siemens and Herr F. Siemens conducted a series of exhaustive experiments, with the result which is now known as the "Regenerative System," which consists in supplying the flame with heated air and gas to enable it to effect complete decomposition of the carboniferous gas. "The apparatus comprises three parts: the *burner* proper, the *regenerator* (in which the gas and air necessary for the combustion is previously heated) in contact with the sides of the *flue*, which sucks down and carries off the products of combustion. The burner is formed by a ring of small vertical copper tubes of about three-sixteenths of an inch in diameter, and of which the number varies from sixteen to thirty-two, according to the size of the apparatus. The gas, in passing up these tubes, becomes still more heated without acquiring a sufficiently high temperature to become decomposed. The relatively large diameter of the burner tubes has the double advantage of preventing any deposit of soot and of checking the too rapid flow of gas. The products of combustion are continuously returned by a downward current to the interior of the burner itself, and there utilised to heat fresh gas and air prior to use. The result is that combustion by this method is absolutely perfect.* These regenerative gas-burners need not be ungainly in appearance; on the contrary, there is even scope for increased elegance of design. It may be worthy of suggestion here that the fittings of the laboratory ought always to embrace artistic principles where practicable, for labour, like digestion, is accelerated when general sensation is rendered suitably pleasant.

The incandescent electric light in vacuo, however, must be acknowledged, *una voce*, to be the best for all domestic purposes, including the illumination of the laboratory, since it cannot impair the atmosphere by consuming oxygen and emitting injurious products. Its invention by Swan and Edison in 1877 now bids fairly to supersede the employment of all other illuminants, but the costliness of the methods in use, and the many technical difficulties yet to be overcome in its several practical applications and the efficient education of workmen and others, makes its universal introduction even in London for many years to come extremely problematical. For these reasons the subject of lighting with oil and gas has been treated of in detail, and it is probable that with the spread of knowledge of the principles of thorough ventilation and warming in relation to the forms of apparatus now used, *e.g.*, the "Defries" lamp, the "Albocarbon," "Omega," "Carburetter," and "Siemens's Regenerative Burner," that oil and gas will continue to hold their places indefinitely as domestic illuminants.

Under the heading of "Hygienic Comparisons between Gas and Electric Light," the following extract is at least noteworthy:—"Some interesting experiments, we learn from the *Builder*, have been recently made at the Royal Theatre, Munich, in order to determine the elevation of temperature and amount of carbonic acid generated under illumination by gas and the electric light respectively. Before the performance commenced the curtain was raised, and all the lamps allowed to burn for an hour, at the end of which time the temperature was observed at intervals of five minutes simultaneously in the parquet, balcony, and third gallery. During the performance, when from five hundred to six hundred persons were in the theatre, the thermometer was observed every ten minutes. The experiments showed that the electric light greatly diminishes the increase of temperature. It does not render ventilation superfluous, but it requires a less active ventilation than gas, since it does not, like gas, contribute to the increase of heat and carbonic acid.*

With all the appliances above mentioned in good working order, there yet remain many seemingly trivial items to be carefully attended to in shielding the laboratory from the incursion of dust and dirt, undue moisture, and other things which have a direct bearing upon the *comfort* as well as the *health* of the student. The prevalent forms of wall decorations and floor coverings employed seem to be especially adapted to the accumulation of filth, whilst many of them are active disease-producing agents. Undue moisture in the air is well known to be a fertile cause of failure in delicate experiments—*e.g.* the pure culture of germs, and the preservation of implements, books, chemicals, &c., from premature oxidation, mouldy growths, and general decay. Moist air thus operates powerfully in physical disintegration, and in supporting myriads of objectionable organic creatures. The remedy need not be expensive, although a costly initial outlay would be saving in the long run, in consideration of its permanent value.

All the woodwork, both exposed and hidden, ought to be rendered impervious and stable by being suitably painted or varnished. This applies as much to the flooring as to the doors, cupboards if any, window-frames, and wall-skirtings. Furniture, as a rule, is always so treated, with but few exceptions, to be noted in the sequel. The paint selected should be non-poisonous,† fire and damp proof, washable, perfectly adhesive with a good body, and not liable to scale off or blister through changes in the weather, &c. The harmless basis known as "Charlton white" may be used in place of the poisonous white lead, and care should be taken to procure non-poisonous driers for use with it. All the good qualities noted, however, are exemplified in "Thompson's magnetic oxide of iron paint" and "granitic paint," with the exception of fire-protective property; the latter can be additionally secured by the preliminary use, as a priming, of the "Patent Liquid Fireproof Cyanite." For the ceiling a washable sanitary distemper, such as the "Silicate Zopissa Composition," ought to be used.

The walls of the laboratory should preferably be painted with some one of the materials already mentioned, and, as the selection and blending of colours can be very tastefully displayed, wall-papers may be dispensed with. Paper, however, is much cheaper than paint, and affords a much larger field for artistic skill; but health and comfort must not give place to the false economy of cheap poisonous wall-papers. Where paper is used the wall ought to be previously lined with an impervious film or coat. "Silicate Zopissa Composition" or "Eastwood's Damp-proof Paper" may be used profitably as sub-linings. The paper itself should be non-poisonous, washable, and free from rough embossed or similar raised work, which is liable to harbour dust. Any kind of paper can now be procured or rendered washable by the leading dealers in such things. Arsenical papers should be avoided; they are not necessarily green in colour—indeed the opposite is now generally found to be the case. It is well known that arsenic, when taken internally in homœopathic doses, is an excellent tonic and skin-purifier, and Mattieu Williams has doubted whether arsenical wall-papers may not, instead of being injurious, prove actually beneficial! There is much truth in the question thus raised, and many arsenical wall-papers may distinctly be shown to be health-giving;

* "Gas Lighting of the Future," pp. 2, 3. 2nd edit. London: 1882.

* "The Illustrated Science Monthly," London, April 1885, vol. iii., p. 120.

† It has been urged that poisonous paints, such as white lead, the basis of ordinary shades of colours, are harmful only when wet, but apart from the fact that this is not strictly true, that circumstance alone should be a sufficient condemnation, most of all in the interests of our labouring artists.

XUM

but as many, if not more, are clearly baneful, so that arsenic should never be administered in this way; its use should be exclusively regulated by the physician and chemist, and when present in wall-papers they ought to be unhesitatingly condemned.

Gossip.

By Richard A. Proctor.

The great earthquakes in Europe and America have brought out the customary supply of prophets after the event, and the customary amount of contradiction in regard to the future—immediate and remote. It need hardly be said, however, that no true student of science, no one indeed having any recognised standing in scientific circles, has joined in the idle chatter by which the Wigginses, Tices, Grimmers, Saxbys, *et id genus omne*, endeavour on these occasions to acquire notoriety since they cannot achieve fame.

* * *

In America Mr. Wiggins, of Ottawa, a half-educated but wholly unscientific man, an *employé* in the Meteorological Office, has been at the pains of announcing a yet more destructive earthquake (in latitude thirty degrees north, in America) than the one by which Charleston suffered so terribly. This might be regarded as mere folly and not condemned as wicked, were it not that, as this man cannot but know, the inhabitants of the disturbed district have suffered from terrible anxieties and fears ever since the earthquakes took place. Many deaths must be attributed to this cause alone, and there have been three (reported) cases of insanity resulting from fright. For a man at such a time to make predictions which he knows to be the merest guesses, simply to gain notoriety, and with the certainty that he must cause much serious mischief—for the weak and foolish are always with us—is the meanest wickedness of which the false-weather prophets and their kind have yet been guilty.

* * *

As I write, news is received from New Orleans that an aëronaut advertises the sale of seats in the car of his balloon on the day appointed by Mr. Wiggins for the destruction of that city.

* * *

I am asked by some correspondents why some scientific matters which bear to some degree on theology are admitted here, and especially the myths of ancient races on which many of the leading religions of the world have been based, and yet theological essays are not admitted. It would be entirely to change the plan of Knowledge to do so. Theology presents as knowable that which we can only treat here as unknowable. To decide between the various dogmas of the theologies of diverse religions would be to pretend to determine what we regard as absolutely beyond the range of human knowledge. If I touch here on matters which many suppose to be associated with religion, and especially to bear on the question whether such and such books and teachings are inspired, I do so strictly because of the scientific bearings of such matters. I personally take no interest in the theological questions on which some of these matters are supposed to bear. If anyone objects to a scientific statement about facts because he cannot reconcile it with his own ideas about matters theological, I may be at the pains to point out that the facts alone concern us here. And such a reply can, of course, be misinterpreted into an attack on some theological dogma. But this is as far from the truth as, for example, the idea would be that Sir John Herschel in measuring the sun's heat was, in point of fact, endeavouring to throw doubts on the tenets of those who worship the sun as a god.

* * *

The small-minded folk who invent out of their own minds a feeble-minded deity, the ignorant who treat as inspired the ideas of men as ignorant in past ages as they (more discreditably) are now, attract much less of the attention of students of science than many fondly imagine.

* * *

I have been long on the look-out for a cricket match in which an innings of double figures should be played; but I have looked in vain (though I know a few such innings are on record) till the recent match between the Australians and an All England eleven at Scarborough, when, as every one knows, the English eleven not only all reached double figures, but all save one passed the score, while none reached treble figures, and the extras reached double figures as well as the individual scores.

* * *

A writer in the *Times*, commenting on my remark two or three years ago that an innings of double figures is thus unusual, seems to draw an erroneous distinction between a case such as this and an ordinary problem in probabilities. He says:—

> Some two or three years ago Mr. Proctor, in Knowledge, stated that no cricket score marking double figures all down the innings had ever come under his observation. The England *v.* Australia match of Friday last supplies the exceptional case. The Yarborough hand at whist does not, I think, justify the traditional odds of 1,000 to 1. This is a matter of pure chance; but that the double-figure record should be unique among picked elevens suggests a curious problem in personal equations. The failure, where single or double only, is never in extras.

But in reality such a problem as this must be regarded as simply a problem in probabilities. Though the chance that an individual player will make a double-figure innings in any given match depends on his skill and the skill of the opposing eleven, yet it remains a chance—nay, in a sense it may be said to be more thoroughly a matter of chance than the tossing of head or tail—seeing that not only is it a chance whether the irresistible ball will come early or late, but it is a chance whether the player will be in his customary form, and even whether previous matches, on which an estimate of his skill has been formed, have really given satisfactory and sufficient means of testing it.

* * *

As a problem in chances one may deal with the case in the following manner, though, of course, opinions will vary as to the averages suggested, and in each match, considered separately, the averages here indicated will be departed from:—

Suppose that, on the average, in every cricket match (between elevens), two players out of an eleven may be expected to reach double figures in 7 cases out of 10, two others in 5 cases out of 10, three others in 3 cases out of 10, two others in 2 cases out of 10, and the remaining two once only in 10 cases. Let us further suppose that the chance of that one, whoever he may be, who is *not out* at the end of the innings, is reduced one half by the possibility that the failure of the player *last out* may occur before the *not out* has reached double figures. Further, let the chance of double figures in "extras" be set at 6 in 10. Then the chance that all the eleven players make double figures, including the *not out*, and that the "extras" run to double figures too, is obtained by multiplying together the chances of the several events, which amount, in all, to 13—viz. 11 for the several players, 1 for the *not out's* extra chance

of failure, and 1 for the extras. It is therefore represented by

$$\tfrac{7}{10}\times\tfrac{7}{10}\times\tfrac{5}{10}\times\tfrac{5}{10}\times\tfrac{3}{10}\times\tfrac{3}{10}\times\tfrac{3}{10}\times\tfrac{2}{10}\times\tfrac{2}{10}\times\tfrac{1}{10}\times\tfrac{1}{10}\times\tfrac{5}{10}\times\tfrac{6}{10}$$
$$=\tfrac{3969}{10,000,000,000}$$

or the chance is less than 1 in 2,500,000 that the double-figure result will come off.

* * *

Of course in special cases the chance would be much higher than this, as when a strong eleven with no tail is opposed to a weak one. It would be a very exceptional eleven, however, for which the above chance would be altered into, say—

$$\tfrac{8}{9}\times\tfrac{8}{9}\times\tfrac{8}{9}\times\tfrac{6}{10}\times\tfrac{6}{10}\times\tfrac{5}{10}\times\tfrac{5}{10}\times\tfrac{5}{10}\times\tfrac{3}{8}\times\tfrac{3}{8}\times\tfrac{3}{8}\times\tfrac{5}{10}+\tfrac{6}{10}$$
$$=\tfrac{1}{200};$$

in other words, the odds against making all double figures would be close on 200 to 1 even in the case of an eleven so strong (as against the opposed eleven) that three of the number would reach double figures eight times out of nine, that two would reach them three times out of five, three in half the number of games played, and the three others three times out of eight.

* * *

The odds against a "Yarborough" are more than 1,827 to 1, though I do not say that would "justify" laying even 1,000 to 1 against an event which may occur at the first trial. I have known two Yarboroughs (*i.e.* whist hands without a card above a nine) in one evening's play.

* * *

The victory of Beach over Hanlan on the Paramatta, and over all competitors on the Thames, gives pleasure to those who have been long troubled by the crafty ways of certain professional oarsmen. The river has been infested by sporting rascality as thoroughly as the turf; and those who have taken interest in rowing and sculling races because of their regard for a manly exercise, and without any of those gambling tendencies which degrade sporting men, have been little aware how often the pulling is arranged before a stroke has been taken. Beach has, and doubtless deserves, the reputation of thorough straightness. If or when he is beaten—long may it be before he is—we shall know that he has been beaten by a better oarsman.

* * *

For my own part, I feel further pleasure in Beach's success because all accounts agree in describing his stroke as precisely that which I have advocated on theoretical grounds as the stroke which must certainly be most effective for the modern racing craft—a strong grip at the beginning, and the best part of the work done in the first half of the stroke. Although very absurd ideas were mistakenly advanced about Hanlan's stroke, as involving a jerk at the end—ideas which, being accepted by other oarsmen in America, have gone far to ruin their style (which probably was intended)—there can be no doubt that Hanlan did more work proportionately in the latter half of his stroke than the mechanical theory of propulsion would justify in light-racing craft, or than any man not so exceptionally built as Hanlan could have ventured on. Whenever Hanlan was fairly extended, however (how seldom that happened we all know), his style was nearly perfect. Beach rows in a style as nearly perfect as seems possible; and his method is that which, since the days when the modern racing-boat was introduced, all the best oarsmen have followed.

* * *

I quote the following account of Beach's rowing from the *Referee*; because, although the remarks on rowing in that paper have always read to oarsmen as if penned by theatrical "supes," or at best by sprinters as the nearest approach to athletes possible with their staff, yet as the *Referee* was formerly obliging enough to comment unfavourably on my own views in regard to rowing (who have, I suspect, rowed more miles than any of their staff have written lines) it is pleasing to be able to quote from that paper what amounts, practically, to a recantation, as the following parallel columns will show:—

From "Notes on Rowing" in the Editor's "Strength and Happiness," pp. 161 and 162:—

I assert confidently, as a result of theory and practice, of observation and of experiment, that for the arms not to be at work in connexion with the body and legs in the earlier part of the stroke is as great a fault in rowing as for them to be at work alone in any part of the stroke. . . . [The rower in the modern light craft should] give up the cherished drag and lightning feather, let the arms be sturdily called into action, in due subordination of course to the body, and in due alliance with the legs from the very beginning of the stroke, so that when the body comes upright the arms have nearly done their work. Let not the stroke be hurried, but a steady (not sluggish) recovery precede the grip at the beginning.

From the *Referee* for September 5, p. 1, col. 4:—

Like Renforth, Beach is very quick in catching hold of the water, and, as did the Novocastrian, lays on directly he has hold. He pulls hard on his stroke throughout, but does most of his work, as oldsters used, in the first half, and not in the second, as the new school do. This development upsets all done in the last few years. The American school went farther than Hanlan, whose vicious wrench at the end of each stroke was one of its chief features. Beach has dropped into the old style, with most of the work done with the sculls at right angles to the boat's line, but a start made in earnest directly they are dropped in. This does not necessitate scamping the remainder, but as carried out is the way that the heroes of the previous generation performed.

* * *

Besides the method of arranging 19 trees in 9 rows, 5 in each, described under the head "Our Puzzles," I have received yet another, fulfilling, oddly enough, the condition I mention as only fulfilled by original solution. I will give this next month, with the solution of the more difficult problem to arrange 19 trees in *ten* rows 5 in each.

* * *

Some readers appear quite to have mistaken several references to my esteemed friend and contributor Mr. Grant Allen in our last. Surely it ought not to need explanation that if I mention him as doing (with marvellous skill and aptitude) what the *Saturday Review* is constantly attacking me for doing, no reproach can conceivably be intended. The remark as to incorrectness in West Indian speech brings Mr. Allen into the same relation with Thackeray and Anthony Trollope, to imagine which to be a slur were assuredly absurd.

Reviews.

Essays in the Study of Folk-Songs. By the Countess Evelyn Martinengo-Cesaresco. (Geo. Redway.)—The essays which compose this delightful book well deserve collection in permanent form, and the publisher has done his share in making that form attractive. Their subjects carry us back to the morning of the world, when the inspiration of the singer came through direct contact with nature, and we are among the company of those whose verse, spontaneous and sincere, is to the poetry of later days as the wildflowers of valleys and meadows to the cultivated beds of parks and hothouses. Their themes are not of intrigues

and low ambitions of an artificial state, but of childhood and love, and the death that blights both; of the fate of men swayed by the gods; of the intercommunion of all living things; of nature in storm and calm, seed-time and harvest —all imbedding many an old-world superstition, worn-out custom, or still active belief. Whilst the authoress has presented her matter with literary skill, she has not permitted this to obscure the historic spirit in which her many felicitous illustrations are interpreted. They are drawn from varied sources—from the far north to the islands of the Pacific—but the larger number are chosen from the rich stores of districts familiar to her, more especially Southern Europe, where the shepherds and the vineyard-dressers have not cast aside the reed of Pan. Very touching are the specimens of lullabies and dirges, very pretty the love-songs and popular lyrics of Venice and Sicily and Calabria, but, as combining philosophic treatment with recognition of deep human interest, we commend the chapter on the Idea of Fate in Southern traditions. Altogether a book alike for the specialist in folk-lore and for the general reader.

Hester's Venture. By the Author of "The Atelier du Lys," &c. (Longmans.)—It would be unreasonable to expect that the high level reached in "Mademoiselle Mori" should be maintained in every subsequent book from the skilful hand that gave us that powerful story; but if the materials of the present tale are more commonplace, the investment of them with an interest that increases as the story advances only witnesses the more to the author's mastery and skill. If there is little to excite, there is enough to attract, in the characters whose friction in the mild intercourse of a Cornish watering-place gives movement to the story. What set of circumstances led to Hester's venture, what was its nature, its strange surroundings and results, must be left to the reader to find out. Both the heroine and her dear old grandmother, the one in her quiet self-dependence, and the other stilled by the patience which is not always the fruit of life's discipline, are attractive enough to keep our sympathies in their fortunes awake, while the contrast presented by the other characters, all life-like in portraiture, from the successful German who vexes the jealous soul of the squire with his schemes for improving the old town, to the mild villain of the story, and the beautiful actress in her Bohemian home in London, complete the lights and shades of a novel which is far above the average.

Still higher amongst the author's works rank the *Atelier du Lys* and *In the Olden Time*, which Messrs. Longmans have issued in half a crown editions, printed in clear type and stylishly bound. The vivid incidents of the one are set in a graphic description of the state of France under the Revolution of '93, while in the other the revolt of the frightfully oppressed peasantry of Germany in the early part of the sixteenth century is the framework of the pathetic story of the concealed Rosilde and the leper *Meistersinger*.

The Dawn of the Nineteenth Century in England. By John Ashton. Popular Edition. (T. Fisher Unwin.)—If Mr. Ashton cannot write history, he can skilfully sift and arrange its materials, and leave on the mind of any intelligent reader a clear impression of the period from which they are gathered. He has in the present work unearthed from newspapers and other fugitive literature of the early years of this century a mass of curious information concerning the social condition of the people, the rigour of the laws under which they lived, and the burden of taxation under which they were crushed. If there be any *laudator temporis acti* among the readers of Knowledge, he may find many a fond delusion dispelled by the facts Mr. Ashton has focussed together, and be thankful that his lot was not cast in the years when the quartern loaf stood at 2*s.* 7*d.*, the income-tax at 2*s.* in the pound, and coals at 48*s.* per ton; when the New River turned on its water supply three times weekly; when the streets were paved with kidney-stones and lit with oil lamps, and locomotion had made no advance since the day when Joseph was carried into Egypt; when a debtor might languish for life in prison, and a man be hanged for stealing a counterpane or a pair of stockings. The daily life of the streets, the diversions of the people in cockpits and gambling-hells, the fashions of the town with its Bond Street mashers and padded old *roués*—all defile before us in the sketches which make up this entertaining and instructive book.

Old Cookery Books and Ancient Cuisine. By W. Carew Hazlitt. (Elliot Stock.)—There is a certain relation between this book and the foregoing, but, although of smaller compass, it covers a wider range in time. Mr. Hazlitt might have cited the relics of hunting feasts in the Reindeer Period of the Ancient Stone Age, in evidence of the high antiquity of cookery; but he contents himself in his introductory chapter with references to the culinary art in Scripture and the classic writers. We may gather from his pages a clear account of the food of the higher and lower orders of the early English, in whose *menu* dishes strange and repellent to our palates appear. We have, however, happily overcome that prejudice against the hare to which Cæsar refers, and the explanation of which it does not occur to Mr. Hazlitt to assign to a totemic origin. The recipes from old cookery books, which fill several chapters, show that our ancestors were adepts in the art of blending good things together, although Mr. Hazlitt, in admitting how we had to summon foreigners to teach us the proper treatment of our ample materials, indorses the grave charge of the French satirist—that we have many religions but only one sauce! In referring to the "Liber cure Cocorum," he is probably not aware that this quaint metrical cookery-book has been edited by the Rev. Dr. Morris for the Philological Society, and, when speaking of the recipe for "goose in a hog-pot" as leaving one in doubt as to its adaptability to the modern palate, has he not mistaken "hotch-pot" for "hog-pot"? But whether he has or has not done this, he has to be thanked for a book commendable both to the antiquary and the housewife.

Longman's School Geography. By G. G. Chisholm, M.A., B.Sc. (Longmans.)—Geography, to the shame of this empire that holds so much of the world in fee, is about the worst-taught subject in our schools, and the result is manifest in the crass ignorance of nine-tenths of educated (?) people as to the whereabouts and features of places the names of which are familiar enough. We, therefore, give special welcome to the present book, which has for its model the masterly text-books on *Erdkunde* in use in Germany, where, determining what is possible and what is impossible in school years, the overloading of the mind with minute detail is wisely subordinated to thoroughness in laying the groundwork. Hence, as Mr. Chisholm says, "the present work will perhaps appear more remarkable for what it omits than what it contains," but he has at least retained what it is most important to know. The information, both in the physical and political sections, is posted up to date, and there are some woodcuts good enough of their kind, but in the room of which we should have preferred a series of block maps. The book is certainly one which should forthwith supersede the majority of manuals in current use.

After London, or Wild England. By Richard Jefferies. (Cassell & Co.)—The undercurrent of melancholy which runs through much of Mr. Jefferies's writings is in full swing

in this weird picture of an England which has relapsed into barbarism, and in which only the scantiest relics of civilisation have survived as curiosities, not even an arch of London Bridge being left on which Macaulay's New Zealander might sit to sketch the site of the vanished city. For in Mr. Jefferies's vision London is covered by marshy ooze, from whose putrid mass is exhaled mephitic vapours fatal to the man who nears its borders, and to the bird that flies across it, and hanging as a low cloud over the rottenness of a thousand years and of many hundred millions of human beings festering under the stagnant waters charged with sewage, and like foul matter. What natural causes operated to bring about this catastrophe are described in the first part, and a piece of very powerful writing it is. The second part introduces us somewhat abruptly to the domestic life of the Aquilas, one of the few surviving families of nobles dragging on an Ishmael-like existence, and the prey of a rapacious tyranny which has usurped sway over "Wild England." As the fortunes of Felix Aquila in his perilous adventures for love's dear sake await their sequel, Mr. Jefferies's readers may in the meantime exercise their ingenuity in discovering whether any or what subtle meaning underlies his fantastic story.

Pendennis. Barry Lyndon. The Newcomes. (Smith, Elder, & Co.)—This convenient and pretty reprint of the great master has beguiled us into renewed reading of works that cannot pall, and that, while never obtruding their moral, tend to lift us out of life's littlenesses into a larger, wholesomer sphere. Whether the more expensive editions be possessed or not, this pocket edition should have a corner of its own.

A New Theory of Astronomy. (Dublin: P. Dixon Hardy & Sons. London: Piper, Stephenson, & Co. 1857.)—We fail to find the slightest justification for the insult offered to a scientific periodical in sending to it for notice such unmitigated trash as this twenty-nine years after the date of its publication.

Papers in Inorganic Chemistry, with Numerical Answers. By GEO. E. R. ELLIS, F.C.S. (London: Rivingtons. 1886.) Yet another aid to the grievously over-examined student! It is only fair, however, to say that any one who can intelligently answer the progressive series of questions contained in Mr. Ellis's volume (as carefully contradistinguished from answering them by rote) must have previously acquired a sound knowledge of elementary chemistry.

Philips' Planisphere, showing the principal Stars visible for every Hour in the Year. (London: Geo. Philip & Son.)—This extremely handy little planisphere is excellently adapted to its purpose, which is to show at a glance the visible heavens at any given hour of the day or night in and about the latitude of London; or, in fact, for practical purposes, in any part of England. The disc on which the constellations are delineated rotates in a leather frame, which is perforated with the elliptical projection of the horizon, the the stars of course being visible through this opening. It is the very thing to lie on the astronomer's library table.

Reading-Books for Home and School: Suggestive Lessons in Practical Life. Second and Third Series. (Smith, Elder, & Co.)—These books, both in matter and style, deserve unqualified praise. They are not made up of clippings after the fashion of their kind, but of clear and informing chapters which are the fruit of wide reading and of a lifetime's practical experience in teaching. All the woodcuts are good, and some of them superlatively delicate.

The Junior Students' Algebra. By ALEX. WILSON, M.A. (London: Crosby Lockwood & Co.)—Mr. Wilson has obviously taken immense pains to render the fundamental principles of algebra intelligible to the beginner. His book only extends to simple equations; but his explanations of the various little difficulties which beset the junior student leave nothing to be desired.

The Arithmetical Class Book. Part I. By Rev. T. MITCHESON, B.A. (London: Bemrose and Sons. 1886.)—*Moffatt's Civil Service Examples in Arithmetic.* By J. HALL and E. J. HENCHIE. (London: Moffatt & Paige.—*Exercises on Mensuration.* By T. W. K. START. (London: Sampson Low, Marston, Searle, & Rivington. 1886.)—*Analysis Tables for Chemical Students.* By R. L. TAYLOR, F.C.S. (London: Sampson Low, Marston, Searle, & Rivington. 1886.)—*German of To-day.* By Dr. N. HEINEMANN, F.R.G.S. (London: Cassell & Co. 1886.)—*Shakspeare's Plays.* Text and Literary Introduction in English and German. "King Lear"; "Henry VIII." (London: Whittaker & Co.)—*Le Verre d'Eau.* Par E. SCRIBE. With an Introduction and Notes by A. BARRÈRE. (London: Whittaker & Co.) Yet another pile of school-books, all more or less adapted to their purpose. Among those possessing some particular recommendation we may perhaps select Mr. Mitcheson's "Arithmetic" and Mr. Taylor's "Analysis Tables" as a little above the average. The rest of the works named above call for no special notice.

We have received Vol. VII. of the *Dictionary of National Biography* (reserved for fuller notice).—*Agnostic First Principles,* by IGNOTUS (Albert Simmons) (Watts & Co.), an accurate and much-needed summary of Mr. Herbert Spencer's famous work; the tone of Dr. Bithell's introduction is admirable.—*Outlines of English History* (Moffatt & Paige), a useful whip to jaded memories, although primarily intended to minister to the mind-killing system of "cram."—The second volume of *British Fungi,* by Rev. JOHN STEVENSON (Blackwood & Sons), completing the work.—Mr. Cole's *Studies in Microscopical Science, August and September* (Birmingham: Hammond & Co.), to which every microscopist should subscribe; the plates alone are worth the money.—Ross's *Notes on Fairs,* a gossipy, informing *brochure* on those primitive mixtures of business and frolic.—*British Fungi, Lichens, and Mosses,* by E. M. HOLMES and PETER GRAY (Swan Sonnenschein & Co.), the latest addition to the useful and marvellously cheap "Young Collector" series.—Mr. Harris Teall's *British Petrography,* Parts V., VI., and VII. (Birmingham: Watson & Douglas), enriched with admirable chromo-lithos of olivine-dolerite and felspar from Derbyshire, the Hebrides, and Scotland.—*The Little Asker; or, Learning to Think,* by J. J. WRIGHT (Swan Sonnenschein & Co.), which utilises the more attractive and striking facts of science for moral lessons. Commendably free from unprovable dogmas.—*The Antiquary* (Redway), giving papers of interest on the orientation of churches in Hampshire, on the ancient boat found at Brigg, with illustrations of the relic, and continuing the late Mr. Cornelius Walford's useful "History of Gilds."—Martin's *Ambulance Work* (Baillière, Tindall, & Cox), well worth its shilling for excellent summary of human anatomy and advice as to treatment of accidents.—Professor Guthrie's wise and scathing *Cantor Lectures on Science Teaching.*—A batch of Cassell & Co.'s useful serial issues: *European Butterflies and Moths; Countries of the World; Our Own Country; Library of English Literature; Book of Health.*—From America we have the *Proceedings of the Academy of Natural Sciences,* Philadelphia; the *American Naturalist;* and the *Smithsonian Report,* 1884, with its valuable *résumé* of scientific work and discovery, notable among which are the interesting finds of the oldest known fossil-fish in the lower Silurian beds of Pennsylvania, and of the oldest arachnids represented by fossil-scorpions in the Upper Silurian of Gothland and Lanarkshire.

XUM

Our Whist Column.

BY "FIVE OF CLUBS."

MATHEWS ON WHIST.

IT seems desirable, when so much attention is being directed to conventional devices at whist, to turn to the work of one who was a master of whist strategy, and thoroughly well acquainted with all those points of play which constituted the science of whist in his day. That whist has advanced since Mathews's time may doubtless be true. It will be seen, as we proceed with his work, that in several points modern whist differs strategically from the whist of the beginning of this century. But the change has been much less than those suppose who imagine that modern whist owes its scientific superiority to the system of conventional signals. I might even say that the advance has been much less than it would have been had not whist strategy been hampered by a system of cumbrous conventions. I believe many readers of the series of papers in which I am about to present the whist of Mathews will be surprised to find how slight the advance has really been since his time, so far as whist strategy is concerned.

But Mathews's book is unfortunately ill-arranged and ill-written. There is, indeed, no arrangement whatever. If he had written evening after evening on separate scraps of paper such ideas as the progress of successive games suggest, and had afterwards piled these scraps in a box and taken them out at random to make his book, he could hardly have produced a more heterogeneous conglomeration of suggestions. Then some of the suggestions are so ill-worded that they will bear two or three interpretations, and only the whist player who, having gone through the work, has learned to appreciate the vigour of Mathews's strategy can tell precisely what he meant to say. In other cases, however, Mathews has succeeded in laying down in a few lines the whole philosophy of a matter about which some recent authors have written chapters, verbosely presenting views inconsistent with sound whist strategy. This is especially the case with the discard. In what follows I have thoroughly rearranged Mathews's matter; and where necessary I have altered his wording: where I follow him inverted commas are used; square brackets where matter is interpolated, unless the addition is very slight:—

INTRODUCTION.

"Whist is a game of calculation, observation, and position."

"Calculation teaches you to plan your game [at the outset] and lead originally to advantage. Before a card is played you suppose the dealer to have an honour and three other trumps; the others each an honour and two other trumps. The least reflection will show that as it is two to one that your partner has not a named card" [that is any particular card not in your hand] "to lead on the supposition that he has it, is to play against calculation. Whereas, the odds being in favour of his having one of two named cards, you are justified in playing accordingly. Calculation is also of use on other occasions, which the maxims will elucidate. But after a few leads have taken place, calculation is nearly superseded by observation. Where the sets are really good players, they are as well acquainted, before half the cards are played out, with the material cards remaining in each other's hands, as if they had seen them. Where two regular players are matched against two irregular ones, it is nearly the same advantage as if they were permitted to see each other's cards, while the latter were denied the same privilege.

"It is an axiom that the nearer your play approaches to that of dummy" [that is, the nearer your play is to what it would be if your cards were exposed and you played what your partner asked for] "the better."

"Calculation and observation may be called the foundation of the game, and are so nearly mechanical, that any one possessed of a tolerable memory may attain them. The science of position or the art of using calculation and observation with advantage is more difficult. Without it it is evident they are of no use. Attentive study and practice will in some degree ensure success; but genius must be added before the whole finesse of the game can be acquired. However—

Est quiddam prodire tenus, si non datur ultra.

GENERAL PRINCIPLES.

"Study all maxims with the cards placed before you in the situations mentioned. Abstract directions puzzle much oftener than they assist the beginner. General maxims presuppose the game and hand to be commencing. Material changes [during the progress of the game] frequently require that a different mode of play should be adopted. Do not attempt to practise [strategic methods] until you have acquired a competent knowledge of the theory [that is, of the theoretical considerations on which they are based]. Avoid as much as possible sitting down with bad players, for it is more difficult to eradicate erroneous than to acquire just ideas. Do not accustom yourself to judge by consequences. Bad play sometimes succeeds where good play would not. When you see an acknowledged judge of the game play in a manner you do not comprehend, get him to explain his reasons, and while [the case is] fresh on your memory, place the same cards before you. When you can comprehend the case, you will be able to adapt it to similar situations."

"Do not at first puzzle yourself with many calculations. Those hereafter mentioned will be sufficient even for a proficient."

"Observe silently and attentively the different systems of those with whom you commonly play. Few players have not their favourite system, the knowledge of which will give you a constant advantage. One leads by preference from an ace, another never but through necessity. [This will often direct you in putting on king second.] The players of the old school never lead from a single card without six trumps; many do so from weakness [in trumps]. Some have a trick of throwing down high cards to the adversary's lead, and then, by way of deception, affect to consider, though they have no alternative. [This, however, is not so much system as acted falsehood.] Observation will enable you to counteract this, and turn it to your own profit. ['Oh, 'tis the sport to see the engineer hoist with his own petard!']

"At the commencement of a game, if you have a good hand, or if your adversaries are considerably advanced in the score, play a bold game; otherwise, a more cautious one. The first object should be to save the game if it appears in probable danger; the next to win it, if you have a reasonable hope of success, by any mode of play, even though hazardous. If neither of these is in question you should play to the score."

The more plainly you demonstrate your hand to your partner the better. Be particularly cautious not to deceive him in his or your own leads, or when he is likely to have the lead. When it is evident the winning cards are between you and your adversaries play an obscure game, but as clear a one as possible, if your partner has a good hand. A concealed game may now and then succeed in the suits of your adversaries; but this should not be attempted before you have attained considerable proficiency; and then but seldom, as its frequency would destroy the effect.

Let the beginner rest assured that without comprehending the leads, modes of playing sequences [and other points of regular play] with an attentive observation of the table, it is as impossible to make any progress in the science of whist as to learn to spell before he knows the alphabet. He must accustom himself to reason by analogy, as the only way of learning to vary his play according to circumstances: he will find that the best play in some is the worst in other situations of the game.

Avoid equally undue daring and extreme caution. One may see "even good players hazard the game merely to gain the applause of ignorant bystanders, by making as much out of the cards as they are capable of; but this pitiful ambition cannot be too much guarded against. On the other hand, some players will never part with a certain trick, though for the probability of making several; they are like fencers who parry well the attack [but are good only in defence]. No player of this kind can excel, though he may reach mediocrity."

"Lastly, I must repeat my advice to proficients, to vary their play according to the set they are engaged with. Recollect that it would be of no advantage to speak French like Voltaire, if you lived with people who were ignorant of the language."

Modern Whist, together with the Laws of Whist. By CLEMENT DAVIES, M.A. (London: Sampson Low, Marston, & Co. 1886.)—This little treatise might better be called "The Laws of Whist, together with Modern Whist," for it is more than half taken up with the laws (without note or comment). Turning to the very limited amount of matter relating to modern whist, about 7,000 words (or four pages of whist matter in KNOWLEDGE), for which Mr. Davies has the conscience to ask four shillings, we find a good deal of this also to be very far from original. Of the preliminary advice sections 1, 2, and 3 are simply naught—and there are only three sections. The matter on playing to the score is as old as short whist itself, and much of it as old as Hoyle. Mr. Davies has here missed, by the way, an opportunity of saying something original; for, oddly enough, while Cavendish, Pole, Drayson, Clay, Cœlebs, Major A., and most other writers have called attention to the advisability of refraining leading trumps when playing for the odd trick, it has not been properly pointed out that the very reason which suggests caution in leading trumps under such circumstances points to an immediate trump lead in many cases under those selfsame circumstances. I

and my partner want, let us say, the odd trick to make the game, therefore the enemy want it also to save the game (or *vice versâ*). We are cautious as to leading trumps first round, lest we should fail to bring in our length and lose the chance of making a trick or two by ruffing. But after a round or two we find that by leading trumps we can deprive *the enemy* of the chance of making a trick or two by ruffing. Therefore we must lead trumps to foil them in regard to the odd trick, which is the same as saying that in such a case a trump lead is indicated as the best way to secure the odd trick. Mr. Davies tries to teach all about the lead in six short pages. This may be done by anyone who possesses some faculty for systematising, and can write succinctly and clearly. How systematic Mr. Davies is and how clear his style may be inferred from a single example. "You should lead," he says, "with Queen, Knave, and one small one, or four small ones, or the ten—the Queen, for the chance of hemming in the King." Of course, a whist-player knows what this means, but certainly the learner, for whom Mr. Davies has been kindly repeating the A B C of the game, will not make much of the rule or of the reason assigned for it; nor will the whist-player agree with Mr. Davies on either point. The lead of Queen from Queen, Knave, ten [and another, or others, usually] is simply adopted in order to establish the suit and make the best use of its strength. The lead of Queen from Queen, Knave, four small ones, is not sound whist; the fourth best card is now the accepted lead, except among those who object to the play of any but the lowest card in such cases. The lead of Queen from Queen, Knave, and a small one may serve to hem the King, as, indeed, may the other two leads of the Queen, but the object is to support partner, if he shall turn out to have strength in this short suit of fours, without giving up all command over it if it turns out to be the enemy's; for if King or Ace captures your Queen, you remain with second best guarded. In dealing with play second hand Mr. Davies ignores all recent inquiries into the advisability of covering an honour when weak in the suit. Passing on to play third hand, lead from weakness, discarding ruffing, &c., we find nothing new in Mr. Davies' teachings; but under the head "Call for Trumps" we find something very original indeed—"You may call for trumps by leading an Ace, then the King, and then a small one, or by winning the Ace and leading the King." We have heard of such nonsensical dodges at suburban clubs; and at Mr. Davies' Union Club, Birmingham, they may be excused. Indeed, by inviting Mr. Davies to publish his remarkable contribution to whist literature, the club convey the idea that such nonsense suits them. But this is emphatically not whist. We need quote only one more sample of Mr. Davies' style. He says, "When strong in trumps endeavour to establish your own long suit; when weak, your partner's." Suppose you have no good suit in the former case, and that he has none in the latter, how then? The fact is, Mr. Davies has not digested such whist experience (chiefly borrowed) as he has obtained. With such a style as his he would do well, even where he understands a subject, to leave literature alone.

Our Chess Column.

BY "MEPHISTO."

DRAWN GAMES.

ONLY a draw! This is a customary expression when honours have been equally divided between two players. The emphasis is put on the word *only*, whilst "draw" is usually pronounced with a melancholy attempt to convey an idea of the uneventful course of the game. It must not be supposed, however, that this expression of disappointment is always justified; for to draw a game requires often a great deal of exactitude, a thorough knowledge of end-games, and a considerable display of ingenuity and skill. A drawn game is also frequently brought about by the sound defence of the second player in the opening of the game. In tournaments, where draws count half, many first prizes have been lost through not being satisfied with an humble draw, and even in matches, where such games do not count, draws, especially when a player is losing, exercise a certain moral influence and slightly revive the drooping spirits. Steinitz is reported to have said, "When I drew my game at St. Louis, I found that all was not lost yet, and my hopes were revived;" at that time his score was 1 to 4.

There are different categories of drawn games. First we have the simple endings of King against King and Pawn, or King and Pawns against King and Pawns, which depend upon niceties of play by which the opposition is always maintained. Bishop against Rook is drawn, with the exception of certain unfavourable positions. The easiest way to draw is to keep the King near the corner of the same colour as the B, when the K is on Kt sq the B will always be able to interpose on B sq or Kt2. Knight against Rook is far more difficult to play. In order to draw the Kt must not separate itself from his K, as otherwise the hostile R will cut it off with the help of the K. No endings have caused more disappointments than King, Rook, and B or Kt against King and Rook: these ought to be drawn, but must be played with the utmost care, especially R against R and B. The end-games of Q against R and P are most useful; if, for instance, Black K on QR2, P on QR3 and R on QKt4 against White, K on QR4 and Q on any square, say K sq, Black will draw; but if the RP is either on R2 or R4, Black would lose. The KtP and R and the BP and R would always draw against a Queen on any square provided the K is cut off, and that there should be no necessity for the R to place himself behind his P. The P will also draw on Q2 and K2, care being taken to keep the R on K3 or B3 accordingly, and the K behind the P; but if the P is either on Q3, Q4, or K3, K4, White would win by being able to attack the K from behind, and thus force him away from his P. Draws of this kind are too numerous to be mentioned here. A very frequent draw occurs through Bishops being of opposite colours, when, in a great many cases, a Pawn more makes no difference.

Next we have draws by perpetual checks. Supposing K on KKt sq, and P's on B2, Kt2, and R3, and other pieces, then check, by the Black Q on QB8 and KB5, is a draw which occurs too often where it could be avoided. In other positions a considerable amount of ingenuity will be exercised to obtain a draw by sacrificing a piece in order to gain a perpetual check. All this should be well known in order either to guard oneself against such draws, or to obtain them as a release from a hopeless game, as in the following example:—

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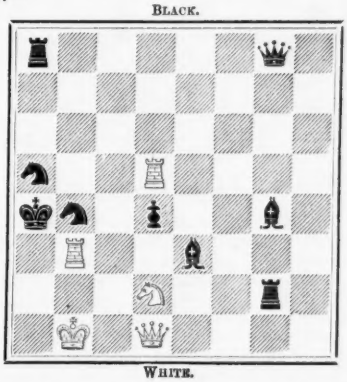

WHITE.

White will draw by 1. R to R3 (ch), K × R. 2. Q to Kt3 (ch), Kt × Q. 3. Kt to B4 (ch), K to R5. 4. Kt to Kt6 (ch) and draws by perpetual check.

Another very interesting draw is obtained by getting into a stalemate position. I cannot think of anything so gratifying to a player, and so trying to the temper of an opponent, than a stalemate. Some players look upon such a performance with a particular satisfaction, and maliciously enjoy the opponent's disappointment. In the following stalemate example we have also the perpetual check idea:—

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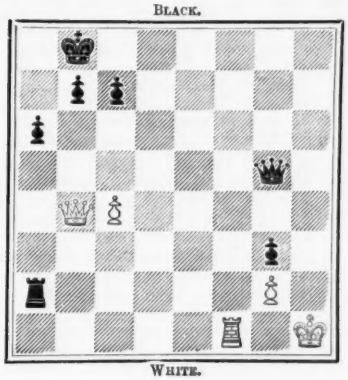

WHITE.

Stalemate follows on 1. R to B8 (ch), K to R2. 2. R to R8 (ch), K × R. 3. Q to B8 (ch), K to R2. 3. Q to B5 (ch). Q × Q. Stalemate. If Black could not take the Q, then White has the perpetual check position referred to above.

It makes a great difference very often how and when you advance a P to the 8th. Sometimes you must delay the advance in order to avoid a draw, as in the following position: White K on QR3 and P on QKt7. Black K on QR8. If White now advances his P at once to the 8th the game will be drawn, for if the P becomes Q or R, Black is stalemate, White will therefore first have to move his K. In other instances you may make a Rook by advancing, but you must not Queen it, as in the following position: White, K on QKt4 and P on QKt7; Black K on QR3. If P to Kt8 (Rook) White wins, but if P to Kt8 (Queen) it is stalemate.

Now all these examples may be much complicated by a greater surrounding of pieces; the lesson, however, should not be forgotten, as the principle equally applies. Not only is it necessary to exercise care sometimes in advancing a P to the 8th to prevent the stalemate, but it is often essential not to make a Queen or Rook, in order also to procure a stalemate, as may be seen from the following example:—

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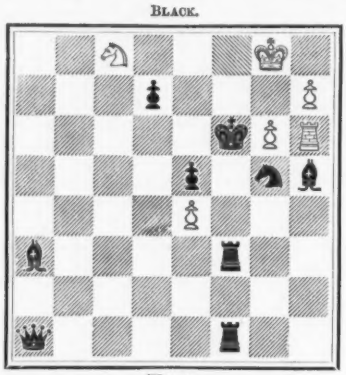

WHITE.

White will draw by 1. P to R8 (Bishop) (ch) K to K3. 2. P to Kt7 (ch), R to B6. 3. R × R (ch), R × R, stalemate. White could not do this by making a Queen on the first move.

From these few remarks it will be seen that even only to draw a game often requires skill and ingenuity. The drawing part of the game is by no means an uninteresting feature of the game. One thing is certain, that players possessing great strength and tenacity, or others possessing less strength but more tenacity, will always draw a good many games. This is more creditable to them than the performance of the player who possesses great brilliance and enterprise, minus judgment or tenacity, who will mostly succeed in losing the same games which the other players would draw.

THE FACE OF THE SKY FOR NOVEMBER.

BY F.R.A.S.

THE Sun may still be watched on every clear day (there are not many) for the spots and faculæ which, in greatly diminished size and number, occasionally appear upon his surface. The aspect of the night sky is shown in map xi. of "The Stars in their Seasons." Minima of Algol ("The Stars in their Seasons," map xii.) will happen forty-five minutes after midnight on the 13th; on the 16th, at 9h. 34m. P.M.; and on the 19th, at 6h. 23m. P.M., in addition to other dates, when their observation will be difficult or impossible. The student should watch for the meteorites radiating from Leo, at and after midnight on the 13th, and for the "Andromeds" all night long on the 27th. Mercury is an evening star throughout the month—in fact, he attains his greatest elongation east of the sun (22° 29′) on the 13th, but his south declination is so great that he is practically invisible. Venus is a morning star, but is so rapidly approaching the sun, and her diameter is so small, that she is, in one sense, not much better placed for the observer than Mercury is. Mars is practically invisible, as are, during the working hours of the night, Jupiter and Uranus too; but Saturn rises before 9 P.M. at the beginning of November, and between six and seven at the end of it. He is situated some 7° to the south of Pollux ("The Stars in their Seasons," map ii.). Neptune comes into opposition to the sun on the 18th, so is capitally placed for the observer. He is about 6° south of the Pleiades, in a perfectly blank part of the sky. The Moon enters her first quarter at 5h. 5·2m. P.M. on the 3rd, and is full on the evening of the 11th at 7h. 6·5m. She enters her last quarter at 10h. 40·3m. at night on the 18th, and is new at 7h. 18·5m. P.M. on the 25th. Of a considerable number of occultations of fixed stars by the moon this month, seven only will occur at hours suitable for observation by the ordinary amateur. They are as follows. On the 3rd, B.A.C. 7263, a star of the 6th magnitude, will disappear at the moon's dark limb at 3h. 16m. P.M. at an angle of 56° from her vertex. It will reappear at her bright limb at 4h. 32m. P.M. at a vertical angle of 288°. On the 7th, 4 Ceti, a 6th magnitude star, will disappear at the dark limb at 5h. 45m. P.M. at an angle from the moon's vertex of 32°, reappearing at the bright limb at 6h. 32m. P.M. at an angle of 321° from her vertex. Later, 5 Ceti, another 6th magnitude star, will disappear at the dark limb at six o'clock at a vertical angle of 48°, and will reappear at the bright limb at 7h. 1m. P.M. at an angle of 311° from the vertex of the moon. Later still, at 6h. 23m. P.M., B.A.C. 5, also of the 6th magnitude, will disappear at the moon's dark limb at an angle of 89° from her vertex, reappearing at her bright limb at 7h. 42m. P.M., at a vertical angle of 281°. On the 9th, ν Piscium, of the 4½th magnitude, will disappear at 6h. 4m. P.M. at the dark limb, at an angle of 60° from the lunar vertex. It will reappear at 7h. 9m. P.M. at the bright limb, at an angle from her vertex of 277°. On the 12th, 48 Tauri, a 6th magnitude star, will disappear at the bright limb of the moon at 7h. 18m. P.M., at a vertical angle of 61°; reappearing at 8h. 18m. at the dark limb, at an angle of 251° from her vertex. Finally, on the same night (12th), γ Tauri, a star of the 4th magnitude, will disappear at the moon's bright limb at 9h. 17m. P.M., at an angle of 55° from her vertex; to reappear at her dark limb at 10h. 25m. P.M., at a vertical angle of 271°. When our notes begin, the Moon is in Sagittarius ("The Seasons Pictured," plate xxi.), through which she is travelling, until 6 P.M. on the 2nd, when she enters Capricornus. It takes her until 4 P.M. on the 3rd to cross the constellation last named, and then she passes into Aquarius. She does not leave Aquarius until midnight on the 6th, at which hour she crosses the boundary into Pisces ("The Seasons Pictured," plate xxii.). She is travelling through this great straggling constellation until 4 A.M. on the 10th, when she arrives at the north-eastern corner of Cetus. She has passed over this by 6 o'clock the same evening and entered Aries. She remains in Aries until 9h. 30m. P.M. on the 11th, and then passes over the boundary into Taurus ("The Seasons Pictured," plate xxiii.). Travelling through Taurus, she arrives at 2h. 30m. P.M. on the 14th at the narrow northern strip of Orion. By 2h. 30m. the next morning she has traversed this and emerged in Gemini ("The Seasons Pictured," plate xxiv.). She remains in Gemini until 6h. 30m. P.M. on the 16th, when she enters Cancer. She quits Cancer for Leo at 6h. 30m. A.M. on the 18th, and Leo in turn for Virgo at 7 P.M. on the 20th ("The Seasons Pictured," plate xxv.). Her journey across Virgo is not finished until 6 P.M. on the 23rd, when she enters Libra ("The Seasons Pictured," plate xxvi.). At 1h. 30m. P.M., on the 25th, she reaches the narrow northern pointed part of Scorpio. Over this she has passed by 10h. 30m. the same night and entered Ophiuchus. This she quits for Sagittarius at 4 P.M. on the 27th. At 2 A.M. on the 30th she enters Capricornus ("The Seasons Pictured," plate xxi.). She is still in Capricornus at midnight.

CONTENTS OF No. 12.

	PAGE
The Unknowable. By Richard A. Proctor	345
The Story of Creation: a Plain Account of Evolution. By Edward Clodd	347
Pleasant Hours with the Microscope. By Henry J. Slack	349
Indian Myths about Night. By "Stella Occidens"	351
Notes on Americanisms. By Richard A. Proctor	352
"Saturday Review" Blunders	354
Are Sun-spots Hollows?	356
Some Puzzles	359
The Sixty-four Sixty-five Puzzle	360
Minute Writing	361
Photograph of Saturn	361
Fifteen School-girls	361
Gossip. By Richard A. Proctor	362
Reviews	364
The Face of the Sky for October. By F.R.A.S.	365
Whist. By "Five of Clubs"	365
Our Chess Column. By "Mephisto"	367
A Malevolent Critic	368

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